Railway Mechanical Engineer

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SCHEDULED FOR THE APRIL ISSUE

An account of the brake trials conducted during 1924 by the German State Railways

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Railway Mechanical Engineer

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Increased efficiency of shop operation

An article on another page of this issue describes the operation of the Finley locomotive shops of the Southern Railway at North Birmingham, Ala. It is an excellent illustration of what may be accomplished by proper inspection and control of labor and material expenditures. These shops have been in operation for approximately five months. During that time, a reduction of from 45 to 50 per cent in labor and material expenditures has been accomplished for Class 3 repairs as compared to the cost of performing the same kind of repairs in the old shops which the new plant has superseded. A large proportion of this reduction is due, of course, to the installation of modern machine tools and shop facilities. However, this reduction would be considerably less if it were not for the functioning of an efficient system of inspection and control of labor and material expenditures. The quality of workmanship and rapidity of production is checked by frequent inspections throughout the day, and by weekly meetings of the supervisory forces. Labor and material expenditures are checked by a daily report which is laid on the master mechanic's desk each morning. This work requires a minimum of clerical assistance; in other words, the overhead cost has not been increased in order to reduce the cost of shop operation.

There are, undoubtedly, numerous shops in which similar systems are in operation and excellent results being accomplished. It is not, however, a universal practice and mechanical department officers in charge of shops performing classified repairs will find many constructive suggestions in the system in operation at the Finley shops.

It's the little things that count

Marked improvements in locomotive performance are, in the majority of instances, brought about by persistent attention to what are often looked upon as relatively unimportant details of operation. The reduction in the number of pounds of fuel used per thousand gross ton miles for freight service and per passenger car mile in passenger service is a factor to which attention is being directed by the majority of mechanical and operating officers. In many instances elaborate road tests are often undertaken at great expense in an effort to discover methods whereby fuel saving may result. The real opportunity to accomplish this is quite often obscured by an effort to determine a single factor by changing which, the result can be obtained. On the other hand, attention concentrated upon a number of small elements in every day operating practices may produce a cumulative saving which will be greater than could be accomplished by a single radical change. Elsewhere in this issue will be found an article dealing with the methods which have been followed for the past several months on the Chicago Great Western which during the third quarter of the past year resulted in an actual saving in fuel consumption of 13.5 per cent per 1,000 gross ton miles in freight service and 9.9 per cent per passenger car mile in passenger service. The methods used were successful in reducing the number of pounds of coal consumed per 1,000 gross ton miles in freight service during the above mentioned period from 172 in 1923 to 149 in 1924, which performance compares very favorably with the fuel records made by other roads handling a similar class of traffic. There was an actual saving of $62,609.43 during this period, all of which was attributed to the nine methods outlined in the article. These methods are worthy of thoughtful consideration and it will be interesting to watch the results obtained by their continued use when future figures for fuel performance on the Chicago Great Western are available.

Take the circular letter seriously

It is the general practice on most railroads to issue from time to time circular letters which contain instructions pertaining to some phase of railway operation. Although these letters are issued in all departments of the railroads, we are chiefly concerned with those put out by the mechanical department. There is an old adage to the effect that for everything done, there is a reason, and the circular letter is no exception. The background for many of these letters is the consistent failure of certain parts of a locomotive or car. These failures are thoroughly investigated to ascertain the cause and the remedy, and the results are set forth in a circular letter for the purpose of instructing the mechanical department as to what procedure to take to overcome these defects. Again it is often found that the workmen are incorrectly making repairs which ultimately lead to failures. In order to standardize the methods of making repairs, a circular letter is issued which sets forth the correct practice to be used. Changes in safety appliance rules often result in the issuance of this form of instructions, which are of vital importance as they act as a safeguard to those using safety appliances such as grab iron, steps, etc.

It should be realized by those for whom the letters are intended that they are compiled at a considerable expense. Considerable time is expended in making investigations and tests in order to ascertain just what instructions these letters should contain.

But, after they are issued, do they serve their purpose? We will assume that the master mechanic and his foremen understand and fully appreciate the purpose of the letters, but do the workmen for whom they are primarily intended? They are generally placed on the bulletin board with the understanding that the men will read them. No

doubt the men do take the time to read them, but do they understand them and do the supervisors know that they understand them?

The mechanical officer in charge of the shops must first make sure that the supervisors under him thoroughly understand the meaning of the letters. They in turn, must determine by personal interview whether the workmen can interpret the instructions given in the letters. Thus, if these letters are understood by all those concerned, car and locomotive failures should decrease, with a corresponding reduction in maintenance costs. Otherwise, they might as well not be issued.

Proper maintenance of machine tools

Why is it that the general practice in railway shops is to run machine tools until they completely break down? Why is it that in the final analysis the mechanical officers find that the cost of machine tool maintenance is considerably more than it ought to be? One reason, and perhaps the most important, is that with attention concentrated on keeping cars and locomotives in repair they overlook the needs of their shop tools until the matter is forcibly brought to their attention by a failure which takes a machine completely out of service.

A supervisor of shop equipment should be made responsible for the proper maintenance of all machine tools. He should have a record of the history of every machine tool under his charge. This record should be kept from the date of purchase of each machine and should include information pertaining to the parts liable to failure along with the date and the character and cost of every repair made.

This officer should provide an organization to take care of every shop containing machine tools. In the larger shops, repair gangs should be organized, the duties of which are to look after the machines in the shops for which they are held responsible. For the small shops one man may be designated to look after the machine tools. He may be included in the millwright gang, but should report to the supervisor of shop equipment. This officer should solicit the co-operation of the foremen in charge of the shops, for it is to their advantage to eliminate machine failures. Again, the foremen should solicit the co-operation of each machine operator for it is to his advantage that his machine be kept in constant operation, particularly if he is working under a piecework or bonus system.

Now, the purpose of this organization is to keep a constant vigilance over the machines to prevent breakdowns and to anticipate failures of the parts most likely to give way. Regular periods of inspection could be advantageously established, at which time the repair men should carefully go over each machine in order to ascertain if there are any parts needing renewal to insure against failure. As time goes on, the officer in charge of this work will have a comprehensive record of the performance of each machine. If a certain part of a particular type of machine is the one that always fails, he should decide whether it is advisable to carry this repair part in stock or whether it would be cheaper to make it in the shops. The best of judgment and common sense will have to be exercised in deciding as to what repair parts should be kept on hand as a considerable sum of money could be quickly tied up in these parts.

It has generally become an established fact that the lack of the proper maintenance of locomotives and cars results in heavy repair costs. Is this just as true with respect to machine tools? Just as the human body needs to be examined carefully and prescribed for by a doctor before rather than after it breaks down, so does the machine tool require timely inspection and proper repairs.

An opportunity—and a challenge!

The following table, taken from an editorial which appeared in a recent number of the Railway Age, is deserving of the most careful thought and study by those who are interested in the continued development and prosperity of the railroads and the communities served by them.

Year	Average number of employees	Wages: Average	Wages: Per cent (*)	Cost of living (In December of each year) (*)	Net ton miles per employee (revenue and non-revenue)	Passenger miles per employee
1913	1,759,000	$761	100	100	186,503	19,258
1916	1,647,097	892	117	118	234,574	20,998
1917	1,732,876	1,004	132	142	248,309	22,779
1918	1,841,575	1,419	186	174	238,872	23,168
1919	1,913,422	1,486	195	199	206,837	24,233
1920	2,022,832	1,820	239	200	211,210	23,158
1921	1,659,513	1,666	219	174	205,340	22,477
1922	1,626,834	1,623	213	169	228,608	21,801
1923	1,855,260	1,619	213	173	245,950	20,462
†1924	1,780,772	1,610	212	170	240,260	20,507

†Estimate based on first eleven months of 1924.
*1913 = 100.

The railways have almost the same number of employees today as they had in the year 1913. These employees are relatively much better paid now than they were 12 years ago, as is indicated by the fact that while their wages have increased 112 per cent, the cost of living has increased only about 70 per cent. The individual employees are apparently giving a better account of themselves, as measured by the increase in the net ton-miles of freight per employee, or the passenger miles per employee, particularly if we take into account the shorter working day. There is, however, some question as to just what part of this increase is due to a greater degree of co-operation on the part of the employees, or to the exercise of a greater degree of individual effort on their part. There has been an increase in property investment of between five and six million dollars in this time, a considerable part of which has undoubtedly been used for facilities and equipment primarily designed to promote more efficient operation. There is little question, also, but what improved methods and practices have been responsible for a much better utilization of equipment and rolling stock.

Railroad managements have no control over the rates which they charge for passenger or freight service, or as to the wages which they pay the employees. They have been handicapped in many of the states and communities by restrictive regulations and legislation of a questionable nature. Taxation has increased at a rapid rate—for the past four years taxes have exceeded the amount of money paid out in dividends. Although the Interstate Commerce Commission was instructed by the Transportation Act to see that the railroads were allowed to earn a reasonable return, they have not, since the Act became effective, been allowed to earn anywhere near as much as the rather low percentage which was established by Congress as reasonable.

The railroad managements are anxious to make additional improvements in the plant and facilities, but their credit has been so impaired that it has been difficult to secure money for these improvements. Most roads have already issued too large a proportion of bonds as compared to the amount of stock outstanding. Something must be done to further improve their credit in order that they may be able to sell stock at par and secure funds with which to carry on improvements which will make for increased efficiency and improved service.

There is probably not a mechanical department officer on any of our railroads but could show where the expenditure of money for much needed improvements would

pay splendid returns. The question is where to get the money with which to make these improvements.

What can the management do to secure a greater utilization of equipment and enlist the interest of all of the employees in cutting out inefficiency and waste and making the best possible use of their energies? Have we given all the attention that we should to getting the best service from all of the workers in the organization—officers and foremen as well as the men in the ranks? Do all of the employees understand the relation of the railroad to the continued prosperity and development of the country? Do they take a real pride in the railway for which they work? Are they doing all they can to boost it and to help in a constructive way to improve its service and to operate it more efficiently and economically?

The art of management is a most complicated problem. Research and study have done much in recent years to reduce it to a science. This does not mean that it must be applied in a mechanical fashion according to certain rule or formulæ. It does mean that the officer with some natural executive ability can greatly increase his effectiveness by getting a better understanding of how best to deal with his fellows and lead them. No more striking development has taken place on the railroads in recent years than the growing understanding of the importance of giving more attention to the human element, and the fact that the interests of the employees, the managements, the public and the investors are mutual.

Never were the conditions so favorable for developing a greater degree of co-operation on the part of all concerned. The responsibility is clearly up to the officers and foremen to make the best of this opportunity and to use all their tact and diplomacy, and the growing fund of valuable information that is at their disposal for developing and improving their leadership ability. With the rates at which the railroads must sell their products and the wages they pay fixed by government agencies, and with the other restrictions that are placed upon them, this would seem to be the only avenue which will lead them out of the difficulties with which they have been so sorely beset for many years.

Steam for blower lines

One considerable fuel waste which can be eliminated or at least reduced at most engine terminals is in connection with the steam blower lines. The amount of steam utilized in these lines and consequently coal burned to generate it in the course of 24 hours, is totally unappreciated except by those who have made a study or test of the actual consumption. As a result, the importance of keeping blower lines tight, insulating them and using blower tips of the correct design and correctly placed to produce the greatest draft in the locomotive front end is often overlooked. Tests made some months ago at the Western Avenue, Chicago, enginehouse of the Chicago, Milwaukee & St. Paul indicate the rate of discharge of steam into the atmosphere at varying steam pressures from blower pipes of different sizes. For example, at 125 lb. pressure, steam will be discharged through a ¾-in. pipe at the rate of about 107 boiler hp.; through a 1-in. pipe, 188 boiler hp.; through a 1¼-in. pipe, 294 boiler hp. The velocity and hence effectiveness of the escaping steam as a draft inducer increases rapidly with the gage pressure up to 75 lb. or possibly 100 lb. when the increase is more gradual and uniform. Most engine terminal blower lines consist of ¼-in. pipe which, with unrestricted volume back of it at 150 lb. gage pressure, will discharge steam at the rate of 345 boiler hp. On account of the smaller pipe commonly used in the drop lines, much less steam than this is actually used. However, the test showed that with a boiler gage pressure of between 125 and 150 lb. the average steam consumption of the blowers is not less than 50 boiler hp. Figuring 6 lb. of coal for a boiler hp. hour and with the blower on for 45 min., this represents about 225 lb. of coal. The entire practice regarding the methods and equipment for blowing up locomotives can well be reviewed at many engine terminals to make sure that avoidable fuel wastes are not being incurred daily.

New Books

DIESEL-ELECTRIC LOCOMOTIVES FOR STANDARD GAGE RAILWAY SERVICE. *By Dr. Eng. Herbert Brown, Baden, Switzerland, 68 pages. Published by Ernst Waldman Press, Zurich, Switzerland.*

This short treatise, in German, considers the possibility of utilizing the Diesel motor for locomotives. In the first general part the currently proposed methods of power transmission—direct drive, change gears, electric and the combined Diesel-steam locomotive—are mentioned and the outlook for the possible application of each discussed. In the second part follows a more detailed study of the Diesel locomotive with electric transmission, which the author considers to be the most promising solution at the present time. The pecularities of the Diesel motor are discussed from the point of view of the demands which are made in locomotive service. Special stress is laid on the problem of cooling, which is discussed on the basis of the known laws of conductivity in so thorough a manner that the author's conclusions are applicable to the cooling problem generally, as well as to its special application on the Diesel engine. The author is a member of the firm of Brown Boveri, Baden, Switzerland.

RAILWAY PIPE FITTERS HANDBOOK, *By Frank J. Borer, acting general foreman, freight car department, Central Railway of New Jersey, 223 pages, illustrated. 4½ in. by 7½ in. Price $2.50. Published by the Simmons-Boardman Publishing Company, 30 Church street, New York.*

This volume contains 19 well illustrated chapters which cover the subject of pipe fitting from every angle of interest for a practical man. The first nine chapters cover fundamental knowledge which every pipe fitter should know. They contain information pertaining to iron and steel pipe, pipe threading, various kinds of pipe fittings and holding tools, measuring pipe and fittings and the hot and cold bending of pipe.

The tools and methods used when stripping pipes from locomotives and cars are covered in chapters X and XI. The drilling and tapping of pipe is discussed at length in chapter XII which is well illustrated for the purpose of clarity. The important subject of shop inspection is next considered by the author. In connection with this subject the importance of air leaks and what they cost in actual money is clearly set forth.

The author leaves the car and locomotive for a time and goes into the subject of estimating radiation for steam and hot water systems. This is followed by a discussion of the various forms of radiating surfaces and how they should be covered, when necessary to prevent radiation. Chapter XXII covers in detail the various types of power cutting and threading machines. The care and repair of dies is also given consideration. The last chapter covers in a thorough and practical manner the specifications for the installation of all types of air brakes including the U. C. equipment. This chapter, if carefully studied, will provide the pipe fitter with sufficient knowledge of the subject to enable him to handle any kind of air brake repairs with dispatch. The book is concluded with an appendix covering instructions on pressure gages.

What Our Readers Think

Derailments of locomotives on curves

A number of letters have been received since the publication of an article, discussing derailments of locomotives on curves, in the December, 1924, and January, 1925, issues of the *Railway Mechanical Engineer,* in which questions have been asked relative to this subject. These questions have been referred to the authors and the questions and answers will be published in this and subsequent issues.—Editor.

A question

Cleveland, Ohio.

To the editor:

The article on Derailments of Locomotives on Curves, part I of which was published in the December, 1924, issue of the *Railway Mechanical Engineer,* states that the greatest number of derailments of Santa Fe type locomotives is due to the number one drivers leaving the rail. Fig. 7, page 724, shows the reactions in the rockers of the engine truck, which I believe is a product of the Commonwealth Steel Company. Assuming that the Santa Fe type referred to in the article is equipped with this type of engine truck, do many derailments occur when the locomotive is running at low speed around curves or through frogs, neither the locomotive or track showing evidence of mechanical defects?

In the case of a Mikado type locomotive equipped with an engine truck of the constant resistance type, would you not be inclined to think that the horizontal thrust would be increased? What conclusion could be arrived at if a similar resistance device were used on the engine truck of a Pacific type locomotive? Occasional derailments of the engine truck have recently occurred on this road with Mikado type locomotives but none have occurred with the Pacific type.

At a recent derailment of Mikado type locomotive in which the engine truck had left the track, an officer of the maintenance of way department stated that he could easily lift one of the engine truck wheels by means of a bar. In this case is it possible that the load on the engine truck is not sufficient to withstand the vertical reaction of the horizontal thrust? Should the load on the engine truck be increased by moving the equalizer pin? A Reader.

The answer

Greenville, Pa.

To the editor:

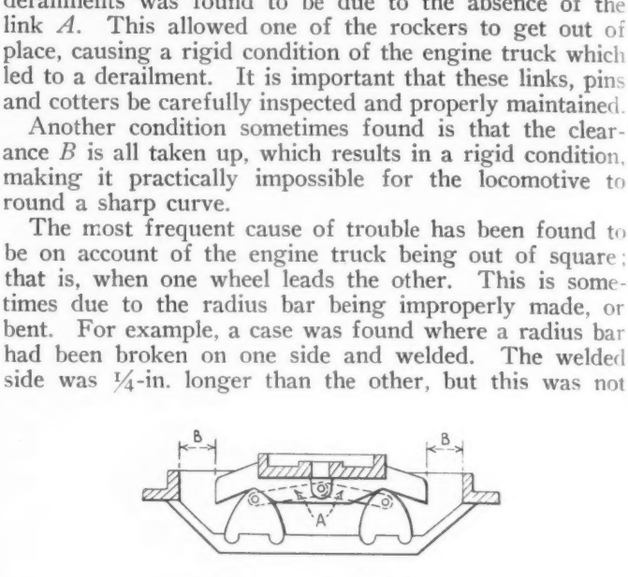
In the article referred to in the letter from "a reader," the authors chose to confine the discussion to the derailments of driving wheels. However, the statement was made that the same method could be employed for the investigation of the factor of wheel bearing on engine trucks as well. In order to do this, it is necessary to assign a calculated value to the horizontal component of the vertical load on the driving wheel and then solve for the vertical reaction on the engine truck wheel. From personal observation, it has been found that engine truck wheels seldom derail because the factor of wheel bearing is too low, but derailments occur more often on account of some rigid or defective condition in the truck.

The Santa Fe type locomotives referred to in the article, are equipped with Franklin Railway Supply Company's constant resistance engine trucks, sometimes known as the Economy truck which were formerly built by the Economy Devices Corporation. There is nothing inherently wrong with this type of truck, in fact it is a very good one, and gives satisfactory performance. Some derailments have occurred with these trucks, but in all cases, the causes have been discovered and corrected.

Referring to the upper figure of the sketch, one of the derailments was found to be due to the absence of the link *A*. This allowed one of the rockers to get out of place, causing a rigid condition of the engine truck which led to a derailment. It is important that these links, pins and cotters be carefully inspected and properly maintained.

Another condition sometimes found is that the clearance *B* is all taken up, which results in a rigid condition, making it practically impossible for the locomotive to round a sharp curve.

The most frequent cause of trouble has been found to be on account of the engine truck being out of square; that is, when one wheel leads the other. This is sometimes due to the radius bar being improperly made, or bent. For example, a case was found where a radius bar had been broken on one side and welded. The welded side was ¼-in. longer than the other, but this was not



Sketch showing the forces set up in an engine truck when all the lateral is taken up

discovered until a derailment had taken place. Sometimes the pedestals become bent, probably due to a previous derailment. In the case of a locomotive which was being derailed frequently, a ⅜-in. shim was inserted between the left back pedestal and the pedestal wearing plate which accomplished the desired result.

It is essential that the engine truck be carefully trammed and squared so that the wheels will line up properly. The distance from the front driver to the engine truck wheel should be the same on both sides and the center line of the engine truck axle should be at right angles with the longitudinal center line of the trucks through the radius bar pin. A condition such as this usually shows itself first in excessive wear of the flange on one wheel, but the condition which allows the flange to wear, also causes the wheel to crowd the rail on that side with the result that it is liable to derail on a switch or frog point or on a curve-worn rail. This condition is aggravated the sharper the flange becomes.

What has just been stated is not peculiar only to the Franklin Railway Supply Company's truck, but also applies to any two-wheel engine truck. This is a disadvantage of the two-wheel truck as compared with the four-wheel engine truck. Perhaps this condition may have something to do with the Mikado type locomotives be-

coming derailed on curves where the Pacific type gives no trouble.

Relative to the question on the horizontal thrust of the engine truck. The function of this thrust is to assist in the rotating of the driving wheel base. There must necessarily be enough weight on the outer truck wheel to overcome the vertical component of the horizontal thrust. One of the features of the engine truck is that the greater the curvature, the greater will be the weight on the outer wheel of the truck. There are some locomotives equipped with interchangeable front and trailing trucks. From conclusions resulting from this investigation, it is believed that this is a mistake, for if the trucks have the same side thrust and are approximately the same distances from the center of the locomotive wheel base, then the thrust of one will offset the thrust of the other. All the trucks will do is to carry weight and not assist in guiding the locomotive. The side thrust of the engine truck should be greater than that of the trailing truck in order to favor the locomotive while running forward.

The statement made by the officer of the maintenance of way department is undoubtedly true. Instances have been seen where the inside wheel of a two-wheel engine truck has risen off the rail as high as two inches, traveling through the air for some distance and then dropping back on the rail again. Being the inside wheel, no harm was done. This is caused by all of the clearance at *B*, in the lower figure of the sketch, being taken up, so that the thrust of the locomotive at *D* and the thrust of the rail at *C*, produces a couple which causes the reaction *E*, which, if the curvature is sufficiently great, will overcome the weight on the truck and lift the inside wheel from the rail or relieve it of enough weight so that it may be lifted by a bar. If the wheel does not rise, and the curvature is sharp enough, the flange of the outer wheel will break, the rail will turn over or the track will move in the ballast.

It may seem strange, nevertheless it is true, that there are some conditions at the rear of a locomotive that have a bearing on engine truck performance. It is sometimes a good thing to see if there is any fouling of the stoker trough, binding of buffer between locomotive and tender, tight safety chains, a fouled trailing truck, etc.

The track also has considerable bearing on the situation. The gage should be standard up to 8 deg. of curvature and then increased ⅛ in. for each 2 deg. up to a maximum of 4 ft. 9¼ in. The gage through frogs should be, regardless of curvature and the guard rail distance, maintained at 1¾ in. These figures are important and failure to maintain them properly is frequently the cause of a derailment.

ROY C. BEAVER,
Assistant mechanical engineer, Bessemer & Lake Erie.

Systematic terminal inspection of locomotives

PRESCOTT, ARIZ.

TO THE EDITOR:

Good terminal inspection of locomotives has long been recognized as having an important bearing on locomotive performance as well as in reducing engine failures. I have known of instances where inspectors were allowed to us their own judgment as to the method of inspection. As a result, each man had a system of his own, or possibly, had no system at all, other than to commence at the front of the engine and inspect the several parts in the order in which they come and then go underneath the locomotive and follow the same procedure. With such a procedure the inspectors usually make note of defects as they are found, or depend upon memory until the whole locomotive is inspected before noting defects on paper.

Considering the size and tonnage rating of the modern locomotive something more than a general or promiscuous inspection of parts is needed. There is no doubt that a simplified system of inspection which will aid the inspector to concentrate on each part inspected will give better results. This can be accomplished by grouping the parts and concentrating inspection on each group separately; "O. K.ing" or making note of the defects found at the conclusion of the inspection of each group.

Noting on paper the results of the inspection of each part on a locomotive would necessitate a long itemized list. Checking each part as "O. K." or "Defective" is impracticable as well as cumbersome. However, inspection by groups has been found to be practicable. It requires

STATION_____ DATE_____ 1925

ENGINE INSPECTION REPORT

ENGINE #_____

GROUP No.		O. K. If No Defects
1.	Safety appliances	
2.	Cylinder and attachments	
3.	Revolving parts	
4.	Valve gear and attachments	
5.	Main and side rods	
6.	Cab and boiler attachments	
7.	Jacket, pipe work and fastenings	
8.	Steam, water and air valves	
9.	Engine and tender frames and attachments	
10.	Engine and tender trucks	
11.	Springs and brake gear	
12.	Driving boxes, shoes, wedges and binders	

DEFECTS TO BE REPORTED BELOW BY REFERENCE TO GROUP NUMBERS

_____
Signature of Inspector.

Report form for inspectors—The various parts of a locomotive are assigned to groups to facilitate systematic inspection

little time and as the various groups become associated in the mind of the inspector, it insures more thorough inspection. It also gives him a check at the conclusion of an inspection by which he can assure himself that nothing has been overlooked.

Group inspection forms, like the one shown, can be made up into pads or in book form similar to the Car Inspector's Record book, which can be conveniently carried and used as a note book. The information on this form may be transferred to the work report form later.

The grouping of parts shown on the form has been found to be well suited for machinery inspection. The arrangement of groups is such that all the outside inspection can be completed before going underneath the locomotive. These groups can be rearranged or added to as desired. A similar grouping of parts may also be used to good advantage by boiler inspectors.

CHAS. RAITT,
Assistant master mechanic, A. T. & S. F.

Diesel-electric locomotive for freight service

Excellent results are obtained in a comparative test with a modern steam locomotive

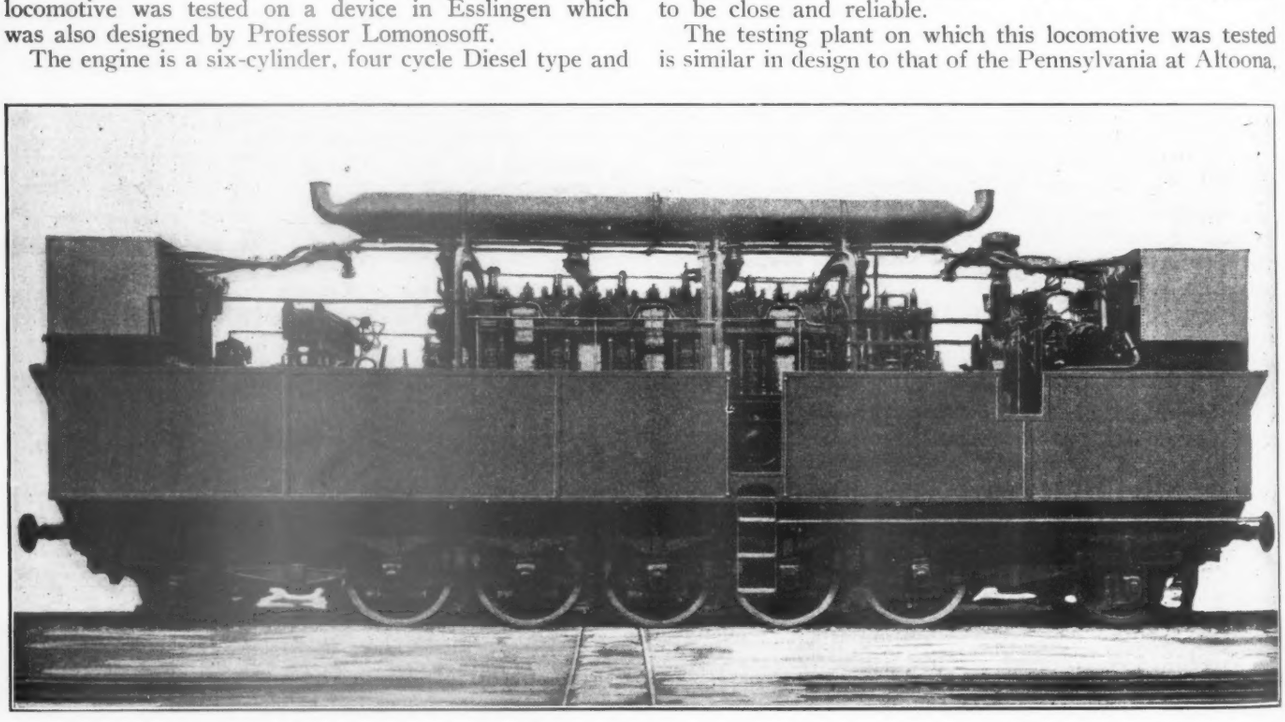
By Dr. J. Stumpf
Privy Counsellor, Berlin, Germany

PROF. GEORGE LOMONOSOFF, technical adviser on railway questions to the Russian government, and his staff have designed a Diesel-electric locomotive for the Russian government. It was built by the Hohenzollern Locomotive Works, Dusseldorf, Germany, at the Esslingen Locomotive Works in collaboration with the Augsburg-Nurulerj Machine Works and the machine works of Brown, Boveri & Company. The locomotive was tested on a device in Esslingen which was also designed by Professor Lomonosoff.

The engine is a six-cylinder, four cycle Diesel type and a result only the most reliable features were selected in the design of the four cycle, single-acting air injection and forced feed oil lubrication. Tests proved the electric transmission device to be most reliable.

The Diesel engine is generally supposed to be in continuous operation. Power is adapted to the requirements of the service by adjusting the voltage of the exciting current of the exciter dynamo. This control has proved to be close and reliable.

The testing plant on which this locomotive was tested is similar in design to that of the Pennsylvania at Altoona,



The engine is located at the center of the car with the air compressors at one end and a dynamo at the other

it is located on the center line of the car with the air compressors for oil injection on one end and a continuous current dynamo on the other. The current from the dynamo operates five motors connected by 1 to 6.14 gearing to each of the driving axles. The hot jacket water of the Diesel engine is cooled in a cooler which is located at one end of the locomotive. The water flows through a piping system cooled by a draft of air forced around the pipes by a fan. This cooler has sufficient cooling capacity to answer all requirements for ordinary air temperatures. However, when operating in hot climates, a second cooler, operated by an independent Diesel engine, may be located on a tender attached to the locomotive.

The cooling device was the most difficult problem in the design of the locomotive. In actual service the Diesel engine proved to be the most critical part, and as Pa. The drivers are run on wheels located in the casement and placed on shafts equipped with water cooled brakes at one end. A continuous adjustment of these interconnected brakes is necessary as the clutches of the brakes showed considerable wear and tear. Sand was always blown between the wheels to prevent slipping. The pull at the drawbar was taken up and measured by a dynamometer device. This, in connection with the circumferential speed of the driving wheels, disclosed the power developed by the driving wheels on the rails.

The resistance and speed were adjusted by the brakes to suit the conditions on the railway from Petrograd to the Caucasus, where the locomotive will later be in service. The first slope on this line is an ascending grade of 2.3 per cent which the locomotive is scheduled to cover in 55 min. The next slope is a descending grade of 0.5 per cent to be covered in 60 min. and the third slope is

an ascending grade of 6.3 per cent to be covered in 94 min. The speed in the three cases is to be 15.69 miles, 18.64 miles and 8.7 miles an hour with a pull at the drawbar of 19,845 lb., 9,922.5 lb. and 33,500 lb. respectively. At the end of the test an exaggerated load was put on the locomotive which brought the pull at the drawbar up to 44,100 lb. and the output of the Diesel engine up to 1,100 hp.

Excellent Results Are Obtained on the Test Plant

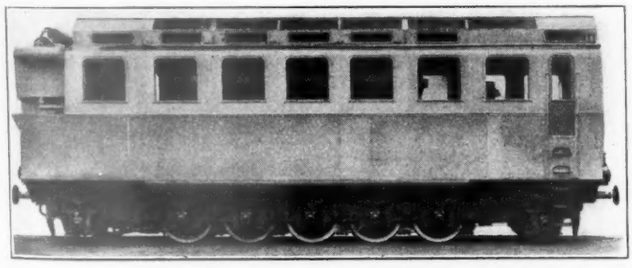
At 8:00 a.m. on November 4, 1924, the Diesel-electric locomotive was put in operation on the test plant. The first test began at 8:30 a.m. and ended at 9:25 a.m. The average drawbar pull was stated to be 20,062 lb., the average output to be 857 hp., the average oil consumption per horsepower hour to be .507 lb. or 42 per cent less than the .88 lb. stipulated in the contract between the Russian government and the Hohenzollern Locomotive Works. The average total efficiency was calculated from the following equation,

$$\frac{\text{circumferential work at the driving wheels}}{\text{heat value of the oil}}$$

which was found to be 27.4 per cent, a result which had never been reached before. The load was varied from 830 hp. to 880 hp. or about 6 per cent. The fan on the cooling tender was not in operation during the tests as the cooling apparatus on the locomotive was sufficient. The cooling water in this apparatus reached a temperature of 117.5 deg. F. with an air temperature of 51.8 deg. F.

The second test started at 9:25 a.m. and was finished at 10:25 a.m., in which time 250.12 lb. of oil were consumed. The average drawbar pull was 9,534.9 lb., the average speed was 18.4 miles an hour, the average capacity was 474 hp. and the average oil consumption per horsepower hour was .522 lb., or 41 per cent less than guaranteed. The average over-all efficiency was calculated from the previous formula to be 26.5 per cent. The load was varied from 440 hp. to 490 hp. or about 9.5 per cent. The fan on the cooling tender was not in operation.

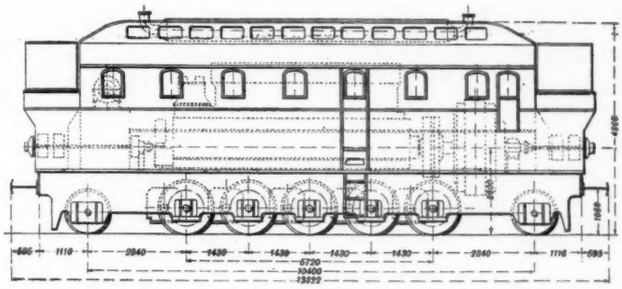
The third test started at 10:35 a.m. The load was



Diesel-Electric locomotive designed by Prof. G. Lomonosoff in collaboration with the Hohenzollern Locomotive Works, Düsseldorf, Germany

increased gradually between 10:25 a.m. and 10:35 a.m. and the test was completed at 12:09 p.m. During that time the main Diesel engine and the auxiliary Diesel engine which operate the fan on the cooling tender, consumed 767.3 lb. of oil. The average drawbar pull was 33,598 lb., the average speed, 9.82 miles an hour, the average output, 890 hp. and the average oil consumption .55 lb. per horsepower-hour, or 37 per cent less than agreed upon in the contract. The total efficiency was calculated to be 25.3 per cent. The load was varied during this test between 860 hp. and 944 hp. or 9.5 per cent. The fan on the cooling tender was in operation for 33 min. The water temperature, at the end of the test, however, was not higher than 150.8 deg. F. with an air temperature of 55.4 deg. F.

The last test was started at 12:09 p.m. and completed at 12:33 p.m. The fans of the cooling tender were in operation during the entire time, decreasing the water temperature from 150.8 deg. F. to 134.6 deg. F. The oil consumption of the main and auxiliary Diesel engine was 234.79 lb. The speed changed from 7.77 miles to 22.49 miles an hour with an output from the locomotive from 645 and 1,066 hp., and the over-all efficiency was calculated to be between 21.1 per cent and 24 per cent. The highest efficiency was stated to be 24 per cent at a



Elevation drawing of the Lomonosoff Diesel-Electric locomotive (Dimensions are in millimeters)

speed of 14.54 miles an hour. The temperature of the electric motors at the end of the test was 149 deg. F. The Diesel engine was stopped at 12:40 p.m. and all parts of the locomotive were found to be in good condition.

Heat values of the fuel oil were determined in the laboratory of the Technical University at Hullgard. A report was made at 3:00 p.m. which stated the upper heat value of the oil to be 42,700 B.t.u. and the lower heat value of the oil, which was Russian naptha, to be 39,820 B.t.u. These calculations were based on a heat value of 39,700 B.t.u.

Observers, consisting of approximately 50 prominent engineers of Russia, Germany and other European countries, who were attending these tests convened at 3:57 p.m. in the conference room of the Maschinenfabrik Esslingen. It was agreed that the Diesel-electric locomotive conformed to all of the stipulations in the contract, that the Diesel-electric locomotive was found to be completely reliable during the operation of 4.5 hrs., and that the low fuel oil consumption exceeded all expectations. The over-all efficiency was found to be between 21 per cent and 27.4 per cent at a load of between 440 hp. and 1,060 hp. during a part of which time the auxiliary Diesel engine on the cooling tender was in operation.

A comparative test with a steam locomotive, having five driving axles, was started at 8:00 a.m. on November 6, 1924. This locomotive was built by R. Wolf, Erfurt, Germany, and the boiler was built by Henschel & Son, Kassel. A membrane of the dynamometer broke at 8:04 a.m. It was the fourth fracture caused by the steam locomotive, whereas no fracture was experienced with the Diesel-electric locomotive. The membrane was replaced and the test was again started at 9:39 a.m. and completed at 10:36 a.m. The average drawbar pull was 19,999 lb., the average speed 15.35 miles an hour and the average output was 835 hp., with the power varying between 810 hp. and 869 hp. or 7 per cent. The boiler was heated with fuel oil, the consumption of which was 1247.8 lb. or 1.62 lb. per horsepower-hour, during the entire test. The total efficiency was calculated to be 8.67 per cent. The gage pressure of the boiler was 180 lb.

Without any interruption, a new test was started at 10:36 a.m. and completed at 11:35 a.m. The average

drawbar pull was 9,479.8 lb., the average speed 18.31 miles an hour and the average output was 468 hp. The output varying between 460 hp. and 505 hp. or 9.3 per cent. The oil consumption during the entire test was 855.5 lb. or 1.84 lb. per horsepower-hour. The over-all efficiency calculated as explained above was found to be 7.6 per cent. The gage pressure of the boiler was 170 lb.

A third test was started at 12:09 p.m. and completed at 12:50 p.m. The average drawbar pull was 31,900 lb., the average speed 10.56 miles an hour and the average output 910 hp., varying between 778 and 925 hp. or 18 per cent. The oil consumption during the entire test was 1,132 lb. or 1.83 lb. per horsepower-hour. The over-all efficiency was calculated to be 7.62 per cent. At the end of the test the gage pressure of the boiler was 180 lb. The test was interrupted on account of the spring of the safety valve on the front cover of one cylinder releasing and allowing a part of the steam to escape. At 12:50 p.m. the speed was brought up to 31.07 miles an hour. At 12:54 p.m. the locomotive was stopped and all parts, with the exception of the above mentioned spring, were found to be in order.

The observers convened at 3:25 p.m. and decided that this locomotive operating with the superheater could be considered as economical, as the total efficiency averaged between 7.6 per cent and 8.67 per cent. This locomotive did not have a feedwater heater. The fuel consumption of the Diesel-electric locomotive was about one third of the steam locomotive and it showed an unusual ease and flexibility of adjustment and also steady operation which should have a favorable effect on the rails.

The author believes that the Diesel-electric locomotive has been realized by the construction of this locomotive and the results of its tests at Esslingen. The engine may be considered as especially adapted for freight traffic. It also exhibits a favorable efficiency in the electric transmission. Professor Lomonosoff, however, does not consider this locomotive to be final, as he is planning to build another Diesel locomotive with spur gearing, for which the Krupp Company has guaranteed a machine efficiency of 96 per cent. As this efficiency is considerably higher than that of an electric transmission and also more simple and cheaper to construct, a Diesel locomotive equipped with spur gearing may be an improvement. However, the flexibility in adjustment is considerably less and a change in gear ratio is not at all safe while running.

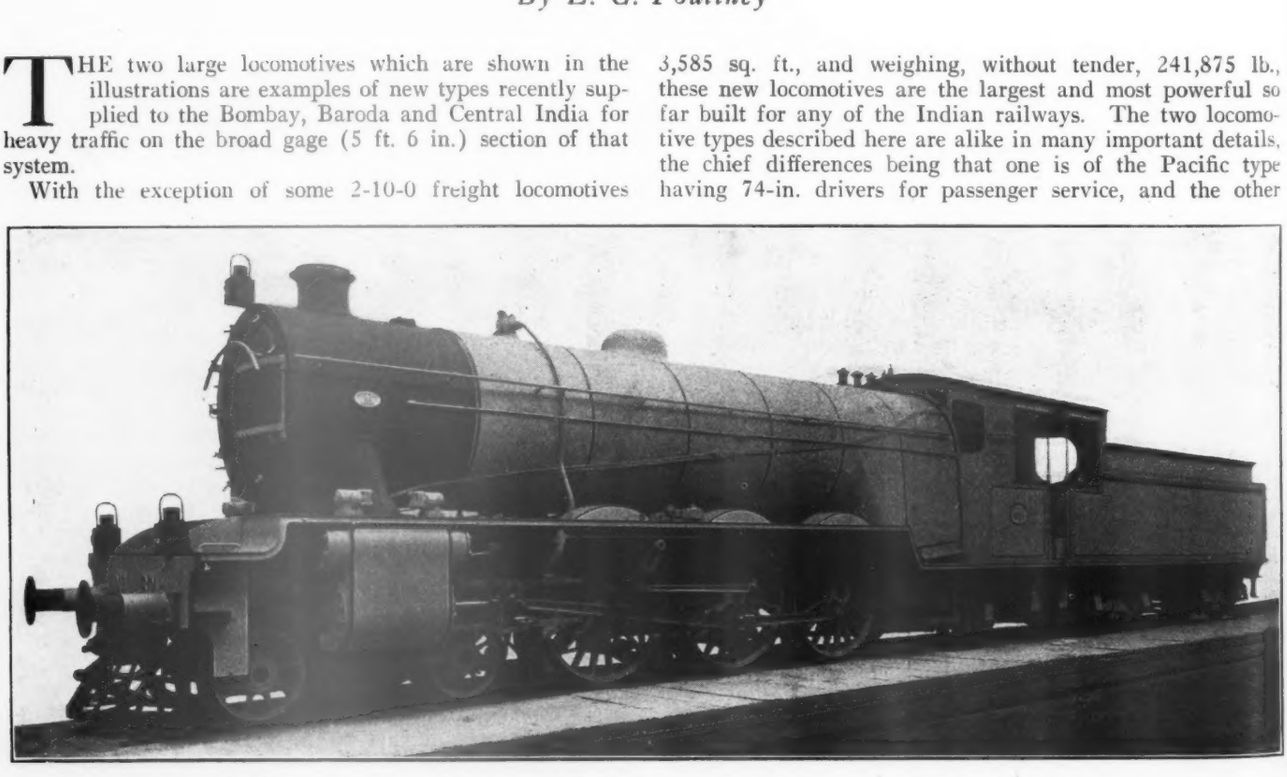
Broad gage locomotives for India

Largest and most powerful two-cylinder types ever built for service in that country

By E. C. Poultney

THE two large locomotives which are shown in the illustrations are examples of new types recently supplied to the Bombay, Baroda and Central India for heavy traffic on the broad gage (5 ft. 6 in.) section of that system.

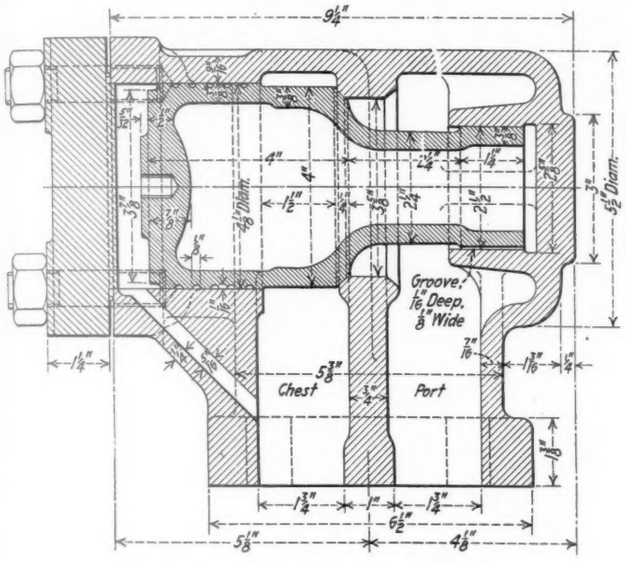
With the exception of some 2-10-0 freight locomotives placed in service on the Great Indian Peninsula about 1921 having four cylinders, each 20 in. by 26 in., a tractive force of 50,000 lb., a total combined heating surface of 3,585 sq. ft., and weighing, without tender, 241,875 lb., these new locomotives are the largest and most powerful so far built for any of the Indian railways. The two locomotive types described here are alike in many important details, the chief differences being that one is of the Pacific type having 74-in. drivers for passenger service, and the other is a Mikado with 56½-in. drivers for heavy freight service. In the design of both the engines and tenders interchangeability has been closely studied. The boilers with their



Pacific type passenger locomotive built for the Bombay, Baroda and Central India

fittings, grate bars and ash pans, are duplicates, as well as the cylinders, valve motion, pistons, piston rods, crossheads, connecting rods, driving boxes, spring rigging, and the trailing trucks. The tenders for both designs are alike in constructional details.

The boilers are of generous proportions, having a total combined heating surface of 2,909 sq. ft., of which 550 sq. ft. is contributed by the 30 element flue tube superheater, which is provided with the Marine and Locomotive Superheater



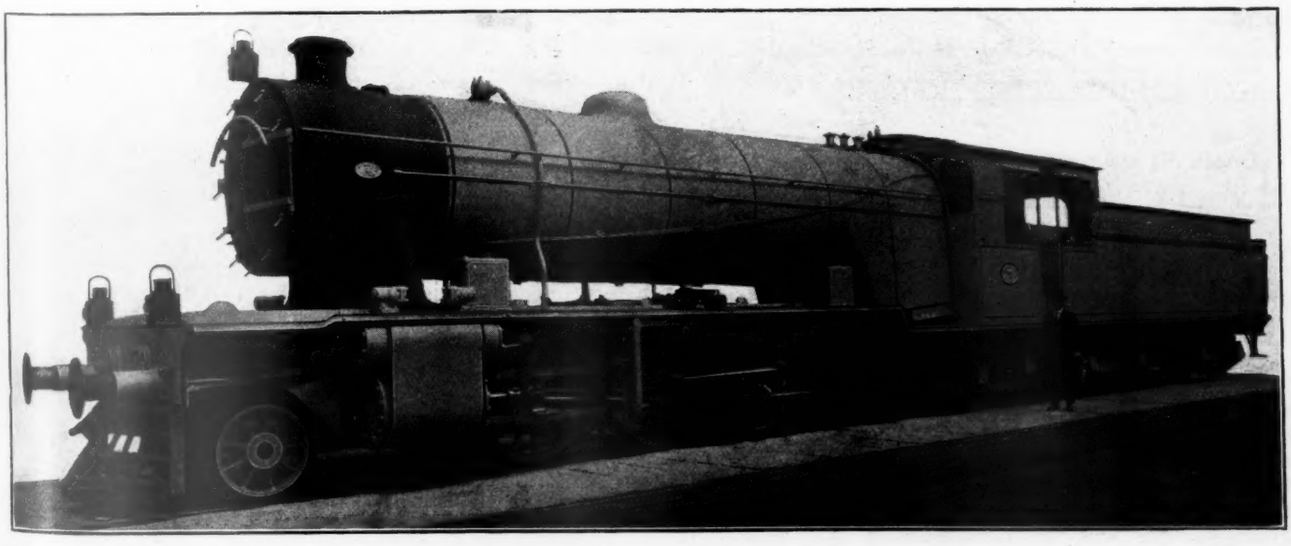
Detail of Hendrie by pass valve

Company's Stirling type header. A large automatic air valve is fitted to the saturated steam side of the header, the function of which is to open when steam is shut off, thus allowing air to be drawn into the elements when drifting. This valve also acts as a vacuum breaker for the cylinders, which are equipped with by-pass valves that will be described later. A wide firebox is provided, giving a grate surface of 48 sq. ft., and the brick arch is supported by arch tubes, four in number. The internal firebox of copper is extended forward into the barrel section, thus forming a combustion chamber. The water space at the foundation ring is three inches at the sides and three inches at the front and back, and the one-inch diameter water space stays are of copper. The crown of the firebox and combustion chamber is supported by direct stays. The stays at the front next the tube sheet are so arranged as to permit of upward expansion. Rocking grate bars are employed with a dumping section at the front end. A top feed arrangement is provided, water being

Table of dimensions, weights and proportions

Type of Locomotive	4-6-2	2-8-2
Service	Passenger	Freight
Two cylinders, diameter and stroke	23 in. by 28 in.	23 in. by 28 in.
Valve gear, type	Walschaert	Walschaert
Valves, piston type, size	11 in.	11 in.
Weights in working order:		
On drivers	133,000 lb.	161,000 lb.
On front truck	40,000 lb.	17,500 lb.
On trailing truck	38,000 lb.	37,500 lb.
Total engine	211,000 lb.	216,000 lb.
Tender	165,000 lb.	161,000 lb.
Wheel bases:		
Driving	12 ft. 9 in.	15 ft. 9 in.
Total Engine	34 ft. 8 in.	33 ft. 9 in.
Total engine and tender	66 ft. 3½ in.	65 ft. 4½ in.
Wheels, diameter outside tires:		
Driving	74 in.	56½ in.
Front truck	36 in.	36 in.
Trailing truck	43 in.	43 in.
Tender truck	43 in.	43 in.
Journals, diameter and length:		
Driving	8¼ in. by 11½ in.	8¼ in. by 11½ in.
Front truck	6¼ in. by 9 in.	6¼ in. by 9 in.
Trailing truck	6½ in. by 11 in.	6½ in. by 11 in.
Tender truck	6½ in. by 11 in.	6½ in. by 11 in.
Boiler:		
Type	Straight top	Straight top
Steam pressure	160 lb.	180 lb.
Fuel	Bituminous coal	Bituminous coal
Diameter, third course	75 in.	75 in.
Tubes, number and diameter	130-2¼ in.	130-2¼ in.
Flues, number and diame er	30-5¼ in.	30-5¼ in.
Arch tubes, number and diameter	4-3 in.	4-3 in.
Length, between tube sheets	18 ft. 0 in.	18 ft. 0. in.
Grate area	48 sq. ft.	48 sq. ft.
Heating surfaces:		
Firebox, including arch tubes	239 sq. ft.	239 sq. ft.
Tubes	2120 sq. ft.	2120 sq. ft.
Total evaporative	2359 sq. ft.	2359 sq. ft.
Superheating	550 sq. ft.	550 sq. ft.
Combined evaporative and superheating	2909 sq. ft.	2909 sq. ft.
Tender:		
Water capacity, Imperial Gals.	6240	6240
Coal capacity	31,360 lb.	28,000 lb.
General data and ratics:		
Rated tractive force, 85 per cent	27,200	40,100
Comb. heat. surface ÷ grate area	60.6	60.6
Firebox heat. surface, per cent of comb. heat. surface*	8.22	8.22
Superheat. surface per cent of comb. heat. surface	18.89	18.89
Tractive force x dia. drivers ÷ comb. heat. surface	692	778
Firebox heat. surface ÷ grate area**	4.47	4.47
Factor of Adhesion	4.88	4.01

* Firebox heating surface, including arch tubes.
**Heating surface, less surface of arch tubes.



Large Mikado built for service in India on 5-ft. 6-in. track

supplied by two self-acting, re-starting injectors of reversible pattern. The boilers are protected by three safety valves set to pop at 160 and 180 lb. per sq. in. for the passenger and freight locomotives respectively.

The 23-in. by 28-in. cylinders are in separate castings bolted to the main frames, and between them is fixed a saddle casting on which the smoke box rests. Piston valves operated by Walschaert gear distribute the steam, and reversal is effected by a hand wheel and screw. The piston valves are arranged for inside admission, and outside steam pipes are applied as shown.

Each cylinder is fitted with two by-pass valves of the Hendrie pattern, a detail of which is shown in the drawing. These valves are very simple in construction, and each consists in this instance of a 4⅛-in. diameter valve working in a suitable annular cavity machined in the body casting, and so arranged that its inner end forms a valve seating on a port connecting the valve chest, live steam side, with the steam port. A passage way of 5/16-in. bore connects the outer end of the valve with the steam chest, so that when steam is admitted to the steam chest by the throttle each valve is held closed. When running with the throttle closed any vacuum formed in the steam chest causes the valve to be drawn from its seat, and connection is thus established between the steam chest and the cylinder at each end, irrespective of the position of the main piston valves. In this manner air may be drawn from the steam chests and elements through the air valve placed on the header casting, and as freely expelled. The lubrication of the valves and pistons is effected by a Detroit four-feed sight feed lubricator.

The springs are all of the usual type, placed above the driving boxes. The trailing trucks have boxes of the Cartazzi design working in curved guides. In the case of the Pacifics the trailing truck is equalized with the driving wheels, and on the Mikado the leading truck and first and second drivers form one group, the third and fourth drivers, with the trailing truck, forming another group.

Solid grease lubrication is used for the driving boxes, the system employed being the Franklin, and the lubricant is that supplied by the Galena Signal Oil Company, Ltd.

The automatic vacuum brake acts on the driving and tender wheels only. There are two 24-in. diameter brake cylinders on the engine and two cylinders 21 in. in diameter on the tender. The braking power for the Pacifics is equal to 72.3 per cent of the weight on drivers and for the Mikados is 71.5 per cent. On the tenders the braking power is equal to 97.2 per cent of the light weight.

The principal dimensions and the important proportions are appended in the tabulated statement.

Generally, these new locomotive types follow usual practice on Indian railways, and in appearance are similar to the standard types which have been in service for many years, though they are very much larger and of much greater capacity. It will be evident from a study of the dimensions and proportions that considerable care has been exercised in working out the designs, and it is reasonable to assume that these new locomotives should give an excellent account of themselves in service. The boilers are of considerable size, a most important feature, and their proportions indicate that they should steam freely.

The locomotives were built by Kitson and Company, Airedale Foundry, Leeds. The designs were prepared and the locomotives constructed under the supervision of Rendel, Palmer & Tritton, consulting engineers, Westminster, London.

How the Chicago Great Western controls use of locomotive fuel

RECORDS of coal consumption and engine failures on the Chicago Great Western show that desirable results in these two particulars have been secured within recent months. There was a saving in fuel consumption of 13.5 per cent per thousand gross ton-miles in freight service and 9.9 per cent per passenger car-mile in passenger service during the third quarter of 1924 as compared with the third quarter of 1923. During the same period engine failures were materially reduced. The following are some of the methods used to attain these results: (1) Competition between divisions with cash prizes for the best fuel performance; (2) educational work by means of bulletins, a rotating illuminated sign in the dispatcher's office and study of a book on correct fuel handling methods; (3) careful attention to water conditions and cleanliness of boilers; (4) use of modern locomotive appliances for reducing fuel consumption; (5) holding locomotives under fire as little as possible; (6) careful attention to the grade of coal used; (7) competition between divisions, crews and enginehouse forces regarding engine failure records; (8) critical analysis of all causes of engine failures.

Fuel saving on the Chicago Great Western for the third quarter of 1924 over the third quarter of 1923

	Tons of coal burned on freight locomotives		Tons of coal burned on passenger locomotives		Freight traffic in thousand gross ton-miles		Passenger traffic in passenger car-miles	
	1924	1923	1924	1923	1924	1923	1924	1923
July	31,049	36,213	10,930	12,186	419,245	433,497	1,449,063	1,479,084
August	35,634	36,891	10,862	12,599	494,303	425,681	1,484,444	1,538,858
September	36,539	38,001	11,526	12,266	469,118	427,748	1,482,510	1,406,258
	103,222	111,105	33,318	37,051	1,382,666	1,286,926	4,416,017	4,424,200

	1924	1923	
Lb. coal burned per thousand gross ton miles	149.3086	172.6673	Saving 23.3587 or 13.5 per cent
Lb. coal per passenger car mile	15.089615	16.749242	Saving 1.659627 or 9.9 per cent
Total estimated saving in 1924 freight service	16,148,64 tons		
Total estimated saving in 1924 passenger service	3,664.47 tons		
Grand total saving in 1924	19,813.11 tons at $3.16 a ton = $62,609.43.		

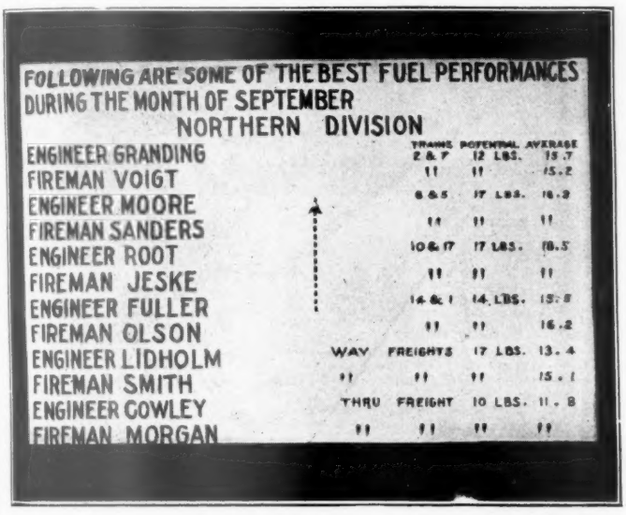
Competition and prizes

A cash prize of $500 is offered every three months for the operating division which makes the best showing in

fuel consumption in freight and passenger service in comparison with the potential consumption for the same period. This potential consumption is computed on a ton-mile basis for freight and on a car-mile basis for passenger service, being 10 per cent less than the actual consumption during the same period in the preceding year. In other words, the potential consumption is a goal or a mark to shoot at. During the third quarter of 1924 a saving of $62,609.43 was made in this service as shown by the attached table.

A cash prize of $200 is offered every three months for the division which makes the best showing in fuel consumption in switching service as compared with a potential consumption per switch engine hour. A saving of about 7 per cent in the amount of fuel burned per switch engine hour was effected in the third quarter of this year.

The results of this competition between divisions and


FOLLOWING ARE SOME OF THE BEST FUEL PERFORMANCES
DURING THE MONTH OF SEPTEMBER
NORTHERN DIVISION
TRAINS POTENTIAL AVERAGE
ENGINEER GRANDING 2 & 7 12 LBS. 15.7
FIREMAN VOIGT " " 15.2
ENGINEER MOORE 8 & 5 17 LBS. 16.2
FIREMAN SANDERS " " "
ENGINEER ROOT 10 & 17 17 LBS. 18.5
FIREMAN JESKE " " "
ENGINEER FULLER 14 & 1 14 LBS. 15.8
FIREMAN OLSON " " 16.2
ENGINEER LIDHOLM WAY FREIGHTS 17 LBS. 13.4
FIREMAN SMITH " " " 15.1
ENGINEER COWLEY THRU FREIGHT 10 LBS. 11.8
FIREMAN MORGAN " " "

Rotating sign developed on Chicago Great Western for use in engineman's room; endless linen strip moves slowly in the direction of the arrow

the awarding of prizes have, therefore, been highly satisfactory. The prizes already awarded have been distributed and used largely for benevolent purposes through the brotherhood organizations.

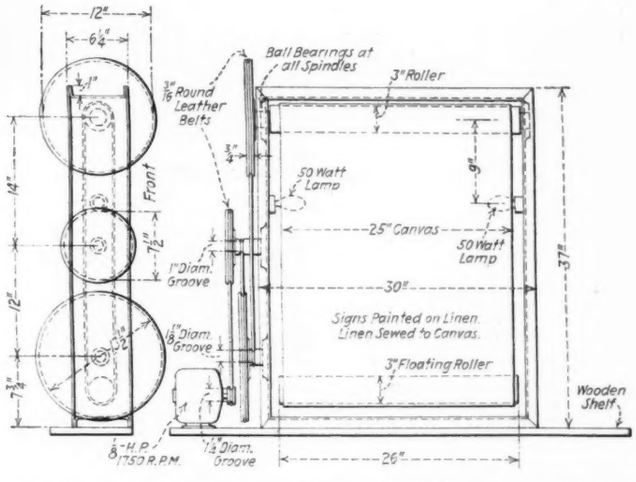
Rotating sign in dispatcher's office

One of the essential requirements in securing effective competition between the divisions is the posting of fuel performance records where they can be seen readily by the crews and others interested. At the enginehouse at Oelwein, Iowa, a rotating sign is used which shows these individual performances and which, on account of its unusual construction, creates a great deal of attention. This rotating sign is located in the enginemen's room on the wall next to the engine dispatcher's window. It consists of a wooden frame, about three feet wide by two feet high, with the performance of the various engine crews painted on an endless canvas-back linen strip which moves continuously from the bottom to the top of the frame. The direction of movement is indicated by the arrow in the illustration. The endless linen strip is driven over suitable rolls by the small electric motor, the rate of revolution being such as to permit easy reading as it moves upward. Two lights back of the wooden frame illuminate the linen strip thoroughly and this with the movement makes it the first thing to catch the eye on entering the room. It attracts attention immediately on opening the door and is frequently surrounded by a considerable group of enginemen and firemen who are anxious to find out what the other fellow is accomplishing. A healthy competition is thus stimulated.

Another factor which should be given partial credit for the fuel performance secured on the Chicago Great Western is the educational work which has been carried on by means of bulletins posted in conspicuous places showing the effects of poor firing and giving specific examples of good practice. Traveling engineers and firemen on each division instruct the crews and offer helpful criticism of their work. A book on the proper use of fuel has also been distributed by the management and this has proved effective in instructing the men in proper methods of firing and the economical use of coal.

Boilers kept clean

Special attention has been given to the treatment of water to eliminate scale so far as possible. Boilers are washed out carefully. On long runs such as the passenger run to Chicago and return, the boilers are washed after every other trip into Oelwein. On the trip that the boiler is not washed the water is changed. Practically all Chicago Great Western freight and passenger locomotives are equipped with superheaters and brick arches. Some of the Mikado and Santa Fe type locomotives have combustion chambers. Thermic syphons are being applied to consolidation locomotives as fast as they come into the shop for new crown sheets. One of the light Mikados has been equipped for purposes of test with a Worthington feed water heater. Good results have been secured with the Superior flue blower applied to a consolidation locomotive running on the Southern division. This effects a large fuel saving, as the locomotive can be run for six or seven trips without knocking the fire. It also makes a great saving in non-effective locomotive hours as the locomotive can be turned in about two hours over the cinder pit.



Details of the driving mechanism and lights for the rotating sign

Every effort is made to have the transportation and the mechanical departments co-operate as closely as possible to avoid holding locomotives under fire in the enginehouse any longer than is necessary. This is checked closely and those responsible for any waste of this kind are severely criticized. All coal received is analyzed and efforts made to secure as uniformly good a grade as possible.

A comparison is made every month of the performance of the various divisions for the previous month as regards

engine failures. This statement shows the individual failures, their causes, the locomotives involved, the places where the failures occurred, amount of delay and the points from which dispatched. It also shows the miles run per engine failure on each division and in total and the per cent of failures to the total number dispatched.

Each failure is entered on a report known as the "Six A. M." report as it occurs. Thorough investigation is made of the persons involved and discipline administered to guilty ones. Broken parts, if any, are sent to the office of the superintendent of motive power and an analysis made to determine the cause of the break. In each case action is taken to attempt to prevent a recurrence of the failure. As a result of these investigations the design of certain locomotive parts may be changed to give more strength or instructions regarding application of the parts revised to correct maintenance methods which are not securing desirable results.

Stationary power plants for railroads

Careful analysis of power requirements facilitates proper selection of mechanical equipment

By Paul R. Duffey

THE modern railroad system has one principal commodity to sell to the public—transportation. To accomplish this economically and profitably is the ultimate aim. The principal agents used to carry on this business when once secured are motive power, rolling stock, tracks, etc., for the maintenance of which adequate facilities must be provided. Such maintenance facilities must depend upon energy in the form of heat and mechanical and electrical power for their successful operation. This naturally brings us to a consideration of the stationary power plant.

It is not the intention of this paper to deal so much with the efficiencies available in the plant, but to bring out the necessity of properly classifying the plants and bringing them up to certain points of standardization as compared to other units in the layout of shops, yards, etc.

From the standpoint of design, installation, operation and maintenance, stationary power plants and their allied facilities, deserve as much thought and consideration as any other important unit.

Classification of power plants

Class 1.—Plants of 1,200 to 2,500 b.hp. and above. On the average system from two to four plants of this size will usually be found located at main shops.

Class 2.—Plants of 800 to 1,200 b.hp. Plants of this capacity will be located at terminals with facilities for receiving and despatching 100 locomotives per 24 hours. Such size terminals usually have facilities for doing considerable car repair work.

Class 3.—Plants of 200 to 800 b.hp. Plants of this capacity are located at the smaller engine terminals, at ore and coal docks, grain elevators, and timber treating plants.

Class 4.—Plants of 100 b.hp. and under. Plants of this size are located at water pumping stations, coach and office heating plants, and for portable service.

We should now group our plants and their allied facilities in such a manner that a close standardization of plants can be established for those covered in Classes 2 and 3. Plants shown in Classes 1 or 4 call for further analysis.

After analyzing present requirements for the four groups of plants, we should add at least 25 per cent reserve to take care of increased requirements for the succeeding ten years after the plant is built.

At this point it is essential that we acquaint ourselves with the requirements of our plant and just what it serves. This leads us to consider the following:

1—THE PRODUCTION OF POWER

Generation of electric power—For turntable motors; coaling station motors; ash pit crane motors; transfer table motors; locomotive hoist and traveling crane motors; electric crane motors; shop motors for driving metal and woodworking tools; electric drills, hammers and fans; battery charging plants; general lighting for shops and yards; special motor-driven compressors and pumps, magnets, etc.

Mechanical power—For steam-driven shop engines; steam-driven fan engines; boiler feed pumps; vacuum pumps; boiler wash and fill pumps; water supply service pumps; fire and emergency pumps; steam-driven air compressors supplying air to shop tools, car repair yards, train testing yard, to coach cleaning and painting of locomotives and cars, hoists and jacks, for blowing sand from dryers to storage bins, for lifting water and to operate signal systems and switches.

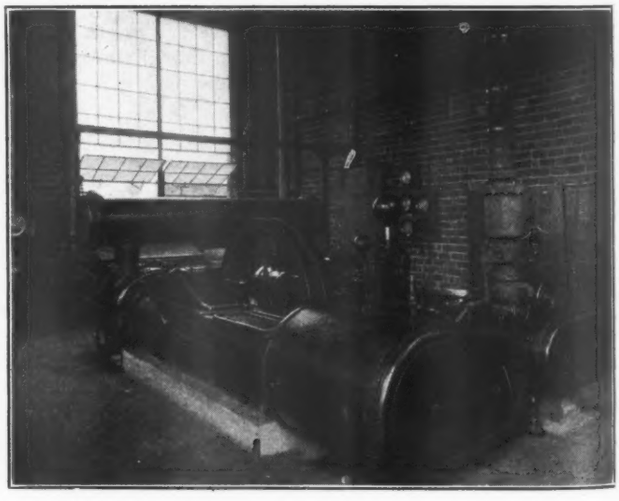
2—STEAM USED FOR ENGINEHOUSE BOILERS

3—STEAM FOR HEATING

Heating required continuously—Oil house and crude oil storage tanks, sand dryers, boiler washing plant, paint shops and dryer rooms, lumber dry kilns, and foundry drying ovens.

Heating required for the winter season—Shops and enginehouse, either by direct or indirect system; offices, storehouses, yard offices, etc.; passenger cars, and thawing devices.

The foregoing items cover the essential classes of service which the stationary plant is called on to serve. In this tabulation are items for which a plant of Class 1 size is required and in some cases a Class 4 plant will serve the purpose.



Air compressor installation featuring large single steam driven unit

Next we must consider the distribution of service and it is well to remember that in working out the distribution we should consider our summer and winter loads. A service distribution sheet should then be compiled to correctly show the charges to be made against the number of departments served by the plant, both on a winter and summer basis.

Such distribution sheets assist us in working out the size of the plant necessary to serve our purpose.

Owing to the fact that the majority of our plants range around 1,200 b.hp. and less, we will consider a plant in that class.

Power plant building

Location—The power plant should be located centrally with respect to distribution of steam, electric current, compressed air and water. Consideration should also be given to the handling of fuel to the plant and ash from the plant.

Construction—Hollow tile, reinforced concrete, or brick should be used in the construction of the walls; the roof

Boiler plant equipped with vertical water tube boilers, stokers, overhead bunkers, continuous coal and ash conveyor, forced draft fan and feedwater heater

trusses should be of steel; the roof of fire-proof construction, provided with ample ventilation for the entire length of the plant covered. Ample windows should be provided for natural lighting and ventilation, steel sash are recommended in preference to wood. Doors of ample size should be provided for handling machinery in and out of the plant. Crane runways should be permanently installed in all plants of over 1,000 b.hp.

Power plant equipment

Boilers—Plants of the size under consideration are usually provided with either the horizontal return tubular boiler or boilers of the water tube type. When a plant reaches such capacity as to require six return tubular boilers (150 b.hp., capacity per boiler) it is quite justifiable to install water tube boilers of larger capacity instead of having a large number of small units.

Stacks—For plants of the size under consideration we should give attention to the erection of a reinforced concrete, or a radial brick stack. For the small plants (under 1,000 b.hp.) steel stacks are suitable, particularly where return tubular or locomotive type boilers are used. Such stacks should be not less than 40 in. diameter, 80 ft. high, built in sections 20 ft. long, material ¼ in. thick, guy bands to be set away from the stack by using spacer blocks welded to the bands before they are fastened around the stack. This method will prevent water, fine ash, etc., from settling at this point and causing the stack to rust away. Stacks should be given at least two coats of fire proof paint before erection. Joints should be closely drawn to place before riveting and all rivets should be driven hot.

Coal and Ash Handling Facilities—For the size plant under consideration usually a trestle is built over a coal bin in front of the boilers, the coal being dumped into the bin direct from hopper cars. For handling ashes in this plant a steam jet conveyor is suggested. For more efficient methods of handling coal and ashes a continuous conveyor such as spiral screw, scrapers, pans, pivoted buckets and endless belts are worthy of consideration. In some cases hoists with a car or skip hoist may be found advantageous.

Feed Water Heating and Regulation—The use of a feed water heater is not only desirable but necessary. Feeding cold water to the boiler is not only uneconomical but detrimental to the boiler. The heater selected should be of ample size, and located in a convenient place near the feed pumps. The open type heater is well adapted to use in railroad power plants and as the construction is very simple, it is not difficult or expensive to maintain. Automatic feed water regulation is desirable and a number of regulators are on the market which have proved successful.

Feed Water Pumps—The ideal type of pump for boiler feeding is the multi-stage, centrifugal, turbine driven pump. However, in the size of plant under consideration we usually find duplex pattern steam driven, outside packed plunger type pumps used. In either case we should install pumps in duplicate units. Feed pumps should be installed on firm foundations and raised at least six inches off the floor. All piping to and from the pump should be the full size of openings provided on the pump. At least two feet clearance should be left around the pumps in order that repair work can be done without cramping the workmen in a small space. Feed pumps should be equipped with excess pressure governors and a water relief valve. Force feed lubricators are preferable to hydrostatic lubricators.

Air Compressors—In the selection of air compressors we have a wide range to choose from; steam driven, synchronous motor mounted direct on crank shaft or electric motor belt drive. Whatever equipment is selected should be of ample capacity. Pipe lines should be of substantial size. Air storage capacity should be amply provided and all such storage reservoirs should be provided with safety valves and a conveniently located drain valve. Where such facilities as pipe lines and storage tanks are liable to freeze they should be kept well drained and also provided with alcohol thawing apparatus.

Steam Engines—Due to the fact that the majority of railroad power plants are called upon to supply large quantities of low pressure steam for heating purposes the steam turbine is only used in the larger plants. For plants such as are under consideration the reciprocating type of steam engine is largely used.

The selection of this type of equipment should be carefully looked into and it is advisable to carefully analyze local conditions in each case. Besides the usual types of engines we find the unaflow engine coming into prominence and there is no doubt as to its being economical and worthy of more than passing note.

Power Plant Piping—The design and installation of power plant piping requires more than the amount of thought we sometimes care to give it and we should in no case lose sight of the following items: Size of lines; use of none but the best grades of materials and carefully separate as between low pressure, medium pressure and high pressure work; provide for proper expansion in steam and hot water lines; provide for proper drainage of all steam headers, to be trapped and the condensate returned to heater or boilers direct; all cut-out valves on boilers, engines and pumps should be located where they are accessible for operation and repair; wherever possible avoid placing pipe lines, fittings and valves in trenches, underground and similar unhandy places.

It is suggested in the larger size plants that the use of

welded headers and pipe be resorted to where possible, in order to eliminate joints and fittings. Welded work is in many cases not only cheaper in first cost but by eliminating the threaded joints and bolted fittings and flanges much longer life of pipe can be expected, with resultant reductions in maintenance costs.

Two methods of welded joints are suggested. One is a butt weld. In the second a sleeve or fitting is used which slips on over the pipe and is welded at each end to the pipe. This method is the stronger of the two and eliminates the formation of fins from welding inside the pipe.

All power plant steam lines, hot water lines, and return lines should be insulated with suitable pipe covering and where such lines are exposed to the weather they should further be protected by covering with roofing paper, canvas sewed on and painted or a galvanized iron jacket, the size and importance of the line to govern the method and kind of covering to use. Air lines buried in the ground should be covered first with one good coat of high grade asphalt paint; after this is dry apply a spiral wrapping of 12-ounce canvas secured at convenient intervals with No. 16 soft drawn copper wire; then give two coats of asphalt paint, and allow to dry before placing the pipe in the ground. Fittings should, where possible, be treated in the same manner.

Additional facilities

Boiler Washing and Filling Plant—This facility has developed so rapidly that it is now an indispensable part of our engine terminal equipment and owing to the necessity of successful operation it is usually taken care of by the power plant forces. The plant usually consists of two large wooden or steel tanks, one containing hot water for filling boilers of locomotives and the other tank contains warm water for washing boilers. In addition we have two duplex steam pumps, one used on the filling line and one on the washout line. We also have a separate line for blowing off locomotives under steam into the tank used for washing boilers. A special arrangement is used for separating the sludge of this blow back water in such a manner that mud will go into the sewer, water will go to the washout tank and the steam vapor will pass into the filling tank. Special float valves on the water lines and thermostatic controlled steam valves take care of the automatic features of the plant.

Fire Protection System—In the power plant we usually place the automatic fire alarm telegraph instrument, with a special code of signals to be sounded from the fire whistle when necessary. The fire pumps are also located in the power plant and such equipment should not only be kept in first class condition at all times but it should frequently be tested. Such facilities should not be used for purposes other than what they are intended for.

Steam Heating System—An exhaust steam heating system is one of the most important and economical parts of our stationary power plant and as it is called upon to furnish heat to shop buildings on an average of 212 days per year, it is one of the excuses we have to offer for maintaining steam driven facilities where cheap electric power can be purchased from central station service.

A well designed exhaust steam heating system is justifiable at all medium sized plants and even in the smaller plants in cold localities such a plant must be provided in order to keep the workmen comfortable.

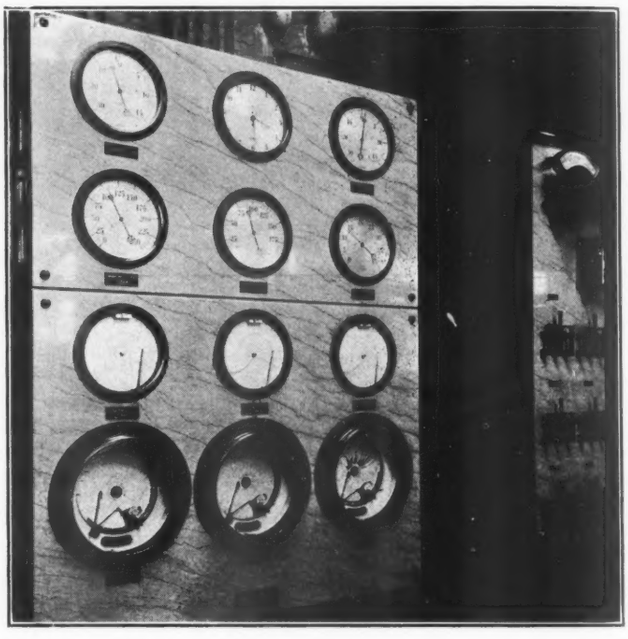
Condensate from the system is usually returned to the feed water heater or boilers by operating the system under vacuum, thus insuring proper circulation and draining of the heating elements at all times.

During the summer or idle period the plant should not be allowed to deteriorate but repairs should be made to all heating elements, valves, traps, vacuum pumps, fans and engines.

Operation and management

To obtain the greatest possible efficiency in power plants is not entirely a matter of design, but a great deal depends on proper operation and management.

In order to operate successfully we must build up an organization composed of a power plant foreman, whose qualifications should be such as to specially fit him for the responsibilities of the important position he is to fill. The man selected should know power plant operation, how to handle men, how to do and pass on work done in the plant by boilermakers, machinists, masons and electricians. He must know how to indicate engines, set valves and make necessary adjustments; understand modern boiler and engine room instruments and their use in his plant. He should also understand the analysis of accounts entering into power costs. A foreman of this character is necessary to the successful operation of all plants over 1,000 b.hp.



An installation of indicating-recording instruments is a necessity for economical operation

In plants under 1,000 b.hp. the position of power plant foreman can be filled by the first shift engineer, this man to have an assistant engineer to relieve him of the operation of engines in order that he may devote more of his time to the details of efficient operation of the entire plant.

In the larger plants our next step in organization is the shift engineers, who are responsible for the successful operation of the plant.

Stationary firemen should be selected carefully and they should be instructed as to their duties in the boiler plant. Coal and ash handlers are primarily unskilled labor, yet in the larger plants this class of labor is usually promoted to better positions as they occur in the fire room, and for this reason some degree of consideration must be given to the selection of this class of help.

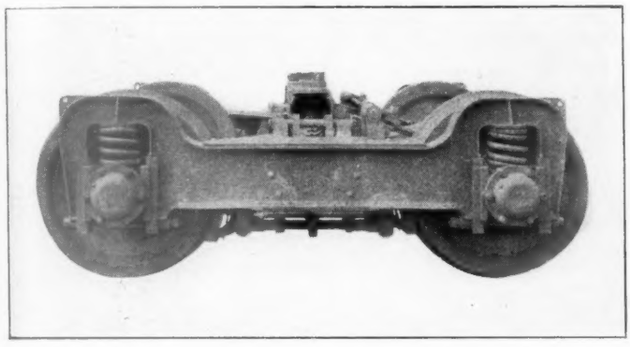
For each district on the railroad there should be at least one man on the staff of the district mechanical officer qualified to follow up all matters pertaining to steam-electric power plants. This supervisor should see that the plants are properly organized, efficiently operated and maintained.

Having built up an efficient operating force it is necessary next to consider the management of this force together with a well defined policy for plant maintenance. No one set of rules can be laid down to fit any two plants without some slight change, and it is not within the scope of this paper to go into details further than to say that the stationary power plant should receive the same consideration as any other unit.

Two-car gasoline motor train

Big Four acquires a combination baggage and mail motor car and 60-passenger trailer for local service on main line

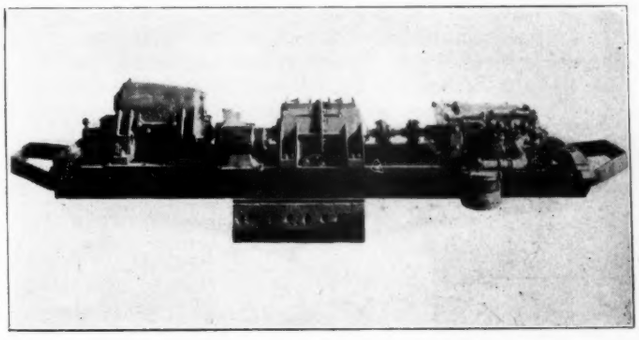
THE Big Four placed in service on Saturday, February 14, between Danville, Ill., and Mount Carmel, on the Cairo division, a two-car gasoline motor driven train, built by the Sykes Company, St. Louis, Mo. Four more trains of the same design are



The four-wheel truck of the motor car

under construction for the Big Four. Two of them will be operated between St. Louis, Mo., and Mattoon, Ill., on the main line, and two between Matoon, Ill., and Indianapolis, Ind., on the main line—all in local service. The outstanding feature of this train is the combination mail and beggage car. This car is the first motor car of its type to have the sanction of the Post Office Department, some of the steam equipment standards of construction of the Department having been modified to meet the conditions of motor train service.

The train consists of a motor coach having a mail compartment, 17 ft. 3 in., long and a baggage compartment 23 ft. 2 in. long, and a trailer coach 51ft. 4¼ in. long, over all, in which seats are provided for 60 passengers. The motor coach is 51 ft. 9⅝ in. long overall, with a body 43 ft. 11 in. in length outside, and 8 ft. 4¼ in. wide at the eaves. The height over all is 12 ft. The trailer coach is 49 ft. 6 in. long over the body and 42 ft. ½ in. long inside of the passenger compartment. The inside widths of the motor and trailer coaches are 7 ft. 10⅛ in. and 7 ft. 11 in. respectively. The height from floor to ceiling of both cars is 7 ft. 7 in. and the elevation of the floor above the top of the rails is 3 ft. 10 in. The distance between truck centers is 37 ft. 2½ in. on the motor

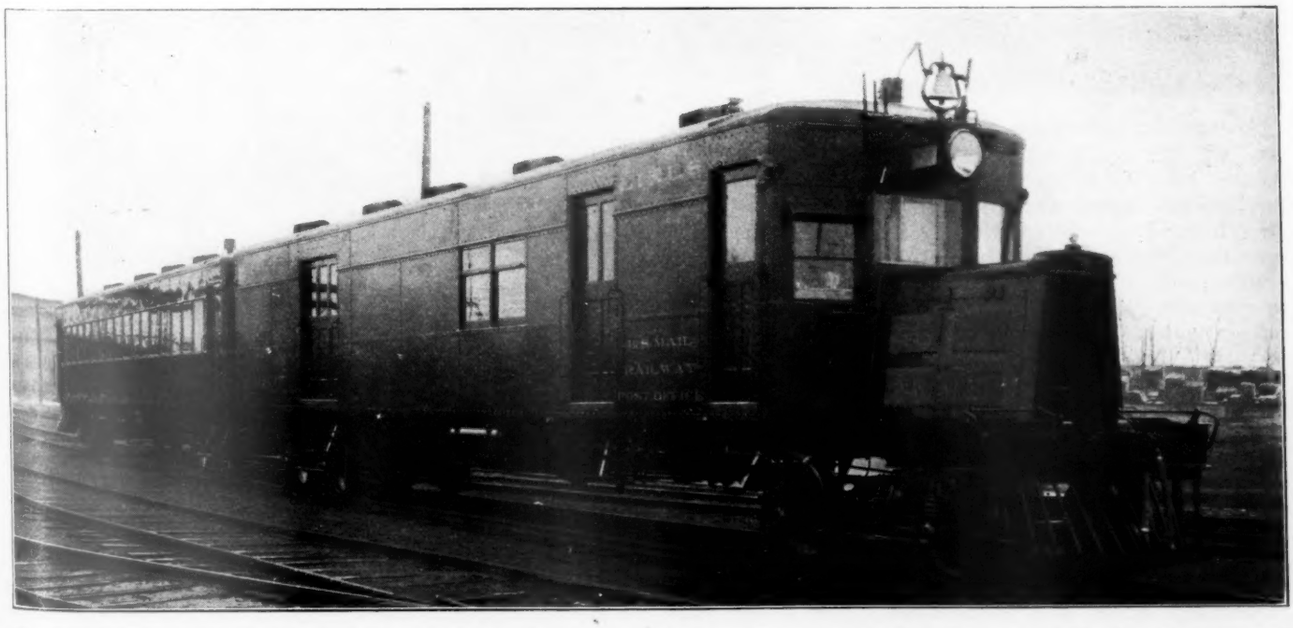


Transmission subframe assembly showing transmission units and two-cylinder air compressor

car and 33 ft. 6 in. on the trailer. The wheel base of the trucks is 5 ft. 2¾ in. and the cars are adapted to pass around curves of 200 ft. radius.

The light weight of the motor coach complete is approximately 42,000 lb. and of the trailer coach 29,000 lb. As the trailer provides seats for 60 passengers this is at the rate of 483 lb. dead weight per seated passenger.

The cars are driven by a Sterling six-cylinder gasoline



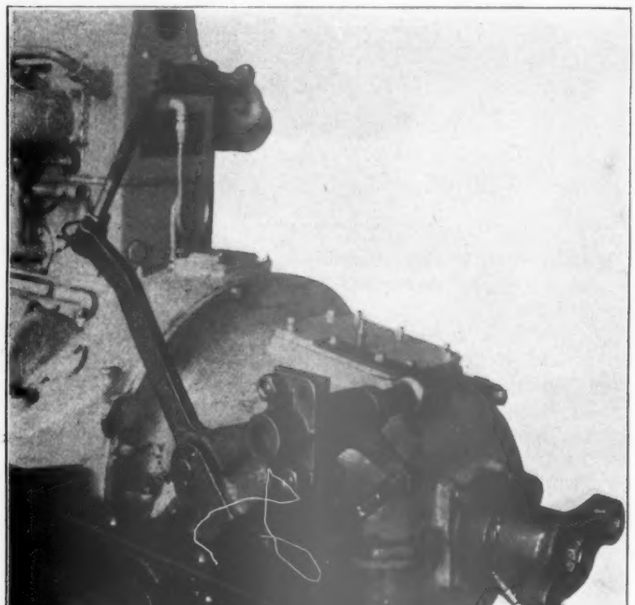
Big Four two-car motor train, built by the Sykes Company, with the motor coach designed as a combination baggage and mail car

motor with cylinders, 5¾ in. bore by 6¾ in. stroke, developing 180 hp. at 1,250 r.p.m. and 245 hp. at 1,750 r.p.m. Electric starting and lighting systems are provided, the generator being directly driven from the engine and of a sufficient capacity to carry all the lights of the train, including the headlight, and to keep the lighting batteries charged to capacity at all times.

A multiple plate, self contained, high capacity clutch is provided, which runs in oil. A special transmission, developed by the Sykes Company, is used. This is so mounted that the speed changing elements may be removed from the coach as a unit on a subframe. The transmission provides for four speed changes ahead, and two in reverse. The low speed gears have a 2-in. face. The third and fourth speed gears are of the herringbone type with 6-in. faces. The speeds provided for are 8.3, 16.7, 33.4 and 44.6 m.p.h. ahead and 7.8 and 10.4 m.p.h. in reverse. The drive is connected by bevel gears on the inside axle of each truck.

The clutch is operated by air

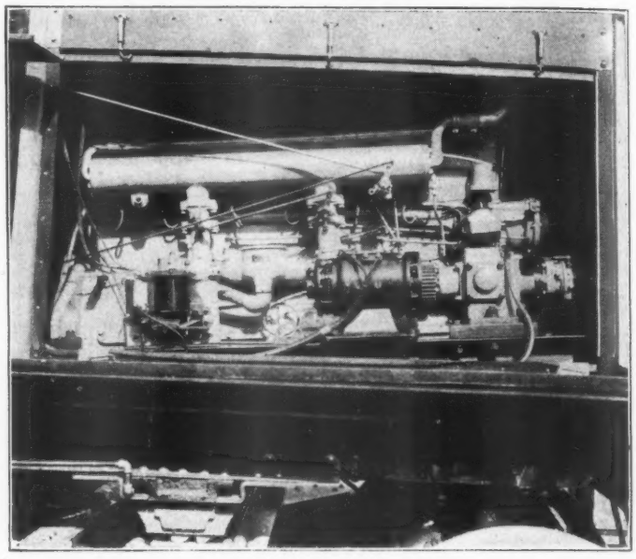
One of the interesting features of the design is an air operated clutch. This development was brought about



Method of mounting the air operated clutch mechanism

by the difficulty of finding a freely operating clutch for mechanically driven cars of large horsepower. A small air cylinder the piston of which is connected to the clutch operating gear so that it assists the foot pressure on the clutch pedal. The first movement of the pedal serves to close the cylinder exhaust valve and open the air admission valve. In releasing the clutch pedal the position of these valves is reversed, and the cylinder pressure exhausted to the atmosphere. The clutch release springs, then function in the usual manner. Another interesting and important feature of design is the use of a subframe suspended by springs from the main frame channels of the motor coach. The transmission units and a two-cylinder air compressor are mounted on this subframe. This method of suspension tends to eliminate gear noises and vibrations from the car body. The entire driving mechanism of the coach may be removed and another unit substituted within two hours time. The power plant itself is mounted in such a manner that it may be removed and replaced within an hour. These features of design are primarily for the purpose of keeping the maintenance cost down to a minimum.

The front and rear trucks are of the standard bolster construction with semi-elliptic leaf springs under the bolster and swinging in a suspended cradle. The wheel



Motor mountcd under the hood—the forward bolster is directly under the engine leaving but four feet of overhang

base is 5 ft. 2¾ in. and wheels 30 in. in diameter. The axles are of chrome-nickel steel, heat treated, 3¾ in. in diameter and have 3¾-in. by 7-in. journals fitted with Hyatt roller bearings.

In addition to hand brakes, the cars are equipped with

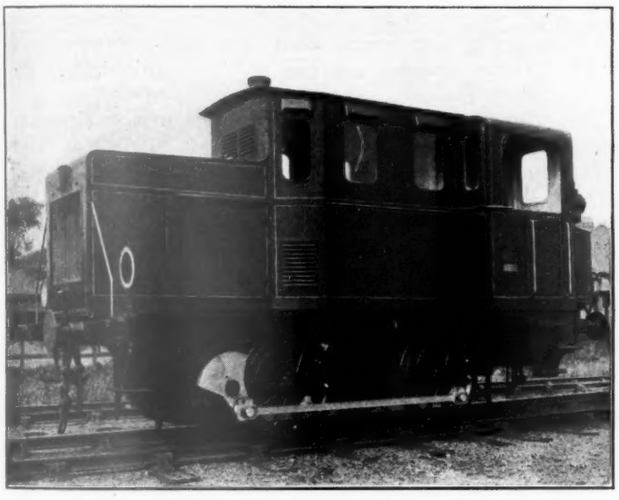
Admission and discharge valves which control the air operated clutch

Westinghouse P. M. and straight air brakes. The air compressor has two cylinders and a capacity of 16 cu. ft. per min. There are two main reservoirs, 16 in. by 48 in. and 10 in. by 24 in. The cars are equipped with A. R. A. automatic couplers at the standard height above the rail.

Hydraulic transmission for Diesel locomotives

Lentz type transmission on switching unit provides three speeds forward and reverse

THE Diesel engine possesses advantages which commend its application to railway locomotives for operation in certain classes of service, such as high thermal efficiency, compact design, cleanliness, ease of operation and particularly the absence of stand-by losses. The internal combustion engine, however, delivers its rated power at a certain speed and it is necessary that some form of transmission be employed which will permit



Switching locomotive, with Lentz transmission, driven by a 60-hp. Diesel engine

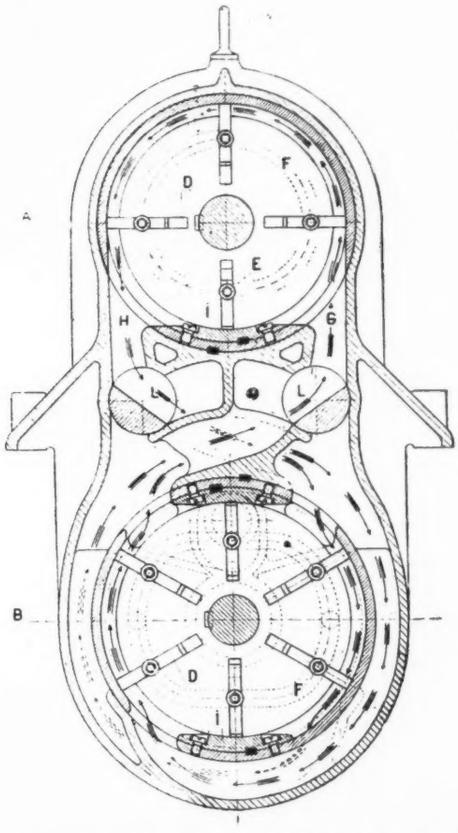
the operation of the engine at a uniform speed while the locomotive works at varying road speeds.

Of the many forms of mechanical transmission perhaps one of the most interesting is the Lentz hydraulic (oil) transmission which has been incorporated in the design of a switching locomotive, using a Diesel engine, recently tried out in England by the London & North Eastern. The main power plant consists of a six-cylinder, four-cycle, high-speed Diesel engine developing 60 hp. at 350 r.p.m. The hydraulic transmission provides three normal locomotive speeds of 3.1, 6.2 and 9.3 m.p.h.; the corresponding tractive force being 4,000, 2,000 and 1,450 lb., with a potential maximum of 4,850 lb. The total weight of the locomotive in working order is 19 tons.

The axis of the motor crank shaft is longitudinal with the main frames, and this shaft is connected directly with the primary section of the hydraulic gear. The secondary section lies immediately below this, at right angles to it axially, its extremities being fitted with balanced cranks whence the drive is by coupling rods to the driving wheels, the crank throw circle being 19⅝ in. in diameter. The suspension of the driving wheels is by ordinary laminated springs.

The hydraulic gear used on the locomotive illustrated is of a type in which the driving and driven shafts are at right angles but, for the sake of clearly explaining the operating principle of the gear, the sectional drawing shown is of a similar gear having the driving and driven shafts parallel.

The shaft of which *A* is the center line is that driven by the motor, and has a cylindrical piston rigidly fastened to it. The sides of this piston are closely embraced by walls in the body casting, which also make contact with it below but leave a space above and around for the greater part of its circumference. Within the periphery of this piston are a number of radial slots *D*, and in these slots are sliding vanes of exact fit which reciprocate in their respective slots and are held by the roller-fitted pins *E* projecting into the cam-shaped groove *F* formed in the side walls of the chamber. This groove (or recess) is found upon either side of the rotating piston and is semi-circular above and flattened below the center line, so that the vanes project and make contact with the roof of

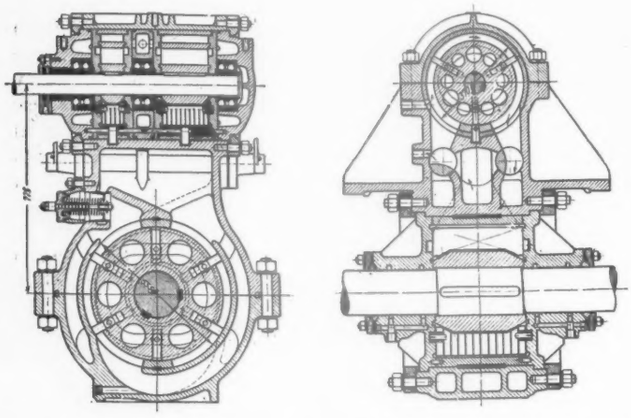


Sectional drawing of Lentz transmission with parallel shafts

the chamber and are withdrawn into the body of the piston at the place where the piston is in contact with the fixed portion of the chamber casting *I*. It will be seen that the projecting vanes on the rotary piston drive before them the liquid contained between the piston body and the chamber walls towards *H* in the direction shown by the arrows; simultaneously drawing out the fluid on the

side opposite at *G*. Leakage is avoided by the accurate fit of the vanes, and there are also labyrinth slots (not shown in the drawing) in the surface of the piece *I*, which separates the delivery and suction sides of the containing chamber.

The liquid, which may be almost any kind of clean lubricating oil, flows in the course indicated by the arrows to the lower and opposite side of the chamber where the stream divides, part entering by the upper inlet and the rest through another passage below. There are corresponding vent passages in the casting by means of which the oil escapes and passes back to the suction side of the pump as explained above. The driven rotor or piston is provided with vanes in the same fashion as the driving rotor which are controlled in the same way; but since



Lentz gear, with shafts at right angles, such as used on the locomotive described

the pressure is exerted simultaneously upon either side in order to equalize the torque, there are two places where the body of the rotor makes contact with the chamber casting, and consequently the guiding cam grooves have flattened contours in two places, as shown. There is practically no wear on the pump vanes because in the course of their radial movement they are relieved of all pressure, the suction space in the rear of the vane being transformed into a pressure space by the next following vane just before it reaches the end of the pressure stroke. As a result of this, the rollers in their turn have then only the centrifugal force, due to the vane itself, to overcome, and, owing to their lightness, perfect fit and continual immersion in oil, wear from friction may be regarded as negligible.

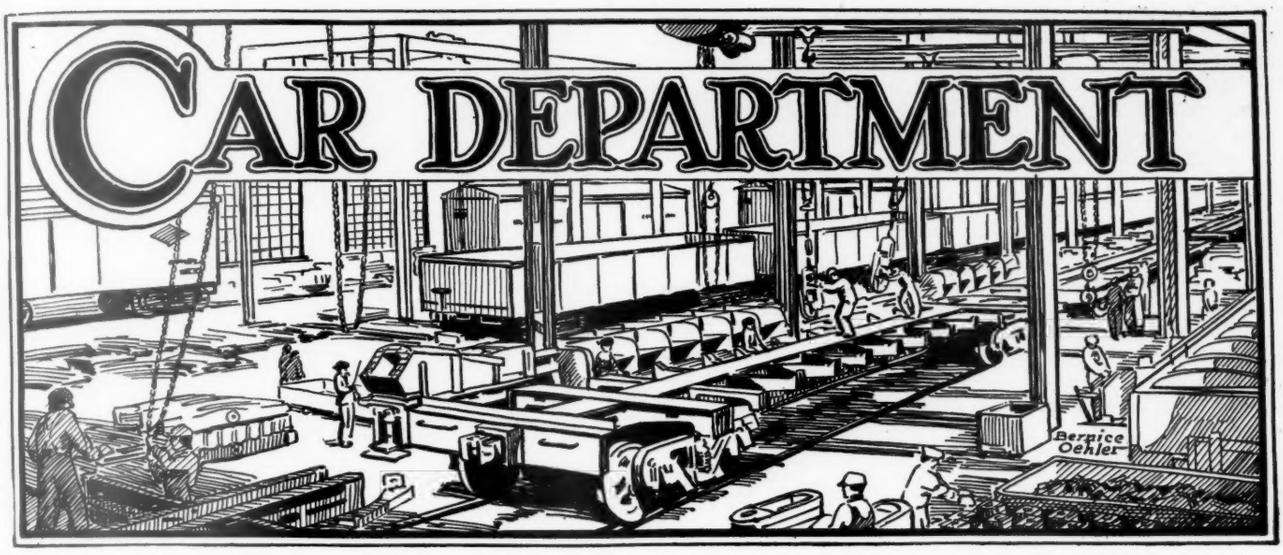
At *L L* are seen two semi-rotary valves, which may be turned to change the direction of the flowing oil stream from one side of the driven piston to the other, and thus alter its direction of rotation.

The foregoing explains the principle by which motion is transferred, from the driving to the driven shaft for either forward or backward running. In order to show how this transmission system acts as a change-speed gear, consider the sectional drawing. It will be seen that the motor driven shaft has two rotors of different widths attached to it, with a separating wall between them. Obviously the smaller piston will drive a lesser quantity of oil before it per revolution than the larger piston, and similarly, by making both pistons work together a still greater quantity is kept in circulation. Meanwhile, the amount of liquid required to displace the driven piston for a given distance is constant, so that by using either the small piston only, the large piston alone, or both large and small pistons in conjunction, three rates of rotation are obtained at the driven shaft from a constant engine speed. These changes are effected by manipulating the rotary valves *L L*.

The disconnection of the driving and driven elements is effected in the simplest fashion by means of a valve built into the center of the casing, which, when closed, divides the pressure chamber of the rotors from the suction chamber of the pumps. It is controlled by a separate lever, and when opened allows the pressure to be neutralized, after which the valves can be moved to any desired position with perfect ease by an arrangement of teeth on the rim of the valve; the pressure is gradually allowed to increase, thus ensuring a perfectly smooth start being effected and no excessive stresses can be generated through careless handling. This valve has the further duty of protecting the transmission by limiting the pressure on the rotor, thus acting as a safety valve, both in forward and reverse directions, and checking any overloads that might develop through too violent a start or a sudden application of the brakes.

The two-piston construction of the driving rotor permits three speeds and reversal. Additional speeds can be obtained by the provision of a third piston, and this is done in some cases, though when more than three speeds are deemed desirable the Lentz system provides a different mechanism than that described.

The shop, office and storehouse of the Boston & Maine at North Billerica, Mass.



Methods of repairing steel cars*

The unit spot system of repairing steel cars is practical and both economical and time saving

By George P. Hoffman

General car foreman, Baltimore & Ohio, Baltimore, Md.

ONE of the most important problems confronting the railroads of this country at present is the repairing and maintenance of steel cars. Each railroad seems to have a different method for making repairs. The greater portion of them are not equipped to properly take care of this important item, and most of this class of work is handled on open repair tracks, without crane facilities. Experience seems to teach that the one method which is completely successful, and efficient for handling this work on open repair tracks is the unit spot system or progressive method.

In order that this system may be carried out, it is necessary to have certain tracks set aside for steel car repairs, and to place the men at different spots on the track, moving the cars down through the tracks, as each operation of the car is completed. This has been developed very successfully by our railroad, organizing the work as shown in the table.

Classification of work and method of designating locations in spot system of car repairs

Color of bulletin board	Symbol	Operation
Red	A	Stripping car for repairs by removing all defective parts that are to be renewed or repaired.
White	B	Repair trucks, underframes, draft gears and attachments.
Blue	C	Fitting and lacing up all parts to place for rivetters, including floors, cross ridge sheets, side hopper, longitudinal hoods, doors, etc.
Green	D	Rivet up parts of car above underframe and apply one coat of paint after quitting time of first shift.
Yellow	E	Apply all safety appliances, hand and adjust doors, repair air brake and hand brake equipment, and applying second coat of paint after quitting time of first shift.
Black	F	Final inspection of cars, tests and adjust brakes, stencil and ship cars.

It is necessary to have all the material to be used at each station, delivered at that point, fabricated, and finished for application, before the men start to work on the cars, so that it will not be necessary for them to move away from their assigned spot for any material. The mechanics who are assigned to the spots perform eight hours' work per day on real mechanic's work, the material being delivered by laborers and helpers, thereby reducing the cost of having mechanics perform work which could be done at a cheaper labor cost.

This system is used in making general repairs, where a car needs renewals of sides and floors, hopper sheets, doors, and other parts of the body. In order that good parts may not be removed and misplaced from cars the work should be checked by a competent car mechanic who should mark up the parts to be removed for replacement, and parts to be removed for repair and replacement. This will insure that the men who are stripping the cars will not destroy a large amount of good usable material.

Rivalry and competitive interests stimulated

It has been found in many places where men are worked under this system, that they will provide themselves with certain shop kinks in order to do their work more efficiently. The men are better satisfied, and will perform a greater amount of work in an eight-hour day than if they were compelled to move their tools from one point to another on repair tracks in order to perform the same operation. A greater efficiency is obtained from the men, for they are continually performing a definite class of work, and become more efficient in its execution each day.

The men at each spot are equipped with the type of tools to perform the particular operation for which they are responsible on each car. This also saves a large amount of tools, as the men on one spot will not require the same tools necessary to perform the operations of other spots.

This system also creates a rivalry among the men who work on the different spots to excel in their work and increase production so that they may lead their fellow-workmen

* From a paper presented at the convention of the International Railway General Foremen's Association, held at Chicago, September 9 to 12, inclusive.

on the competitive spot and the competing unit. In other words, it has a natural tendency to promote competition among the men to produce better results in handling cars through the shop. In order to work the system to the best advantage, of course, it is necessary to have an adequate number of cars passing through each spot daily, which will be gaged by the number of men employed in each unit.

Prompt delivery of material essential

One of the important requirements in carrying out this work is to see that the material is delivered promptly. It has been found that doing this with man power has not produced desired results, and therefore a tractor or an electrically driven truck should be used to deliver the material. They should be kept in continuous operation, to and from material bins and platforms of the various spots. There should be a number of material trailer trucks, to be set off, where the material is to be laid up and the scrap to be hauled away. When loaded, a card is placed in the pocket at the end of the truck, designating to which spot the material is to be delivered. When the operator handling the tractor comes along, he immediately knows by examining the card the destination of the trailer.

The average life of a steel hopper car is estimated at about 15 years, when its superstructure should be rebuilt. This should prolong the life of the car 15 years. It is considered good practice to patch steel cars until the floors and sides have uniformly worn out, after which such parts should be replaced new, and should extend the life of the car about 15 additional years. It should not be considered good practice to allow cars to run which have deteriorated, without substantial patching, which will replenish the lost strength from deterioration. When a car is continued in service in this condition, it is very apt to buckle or collapse, which causes an enormous expense to any railroad in accidents.

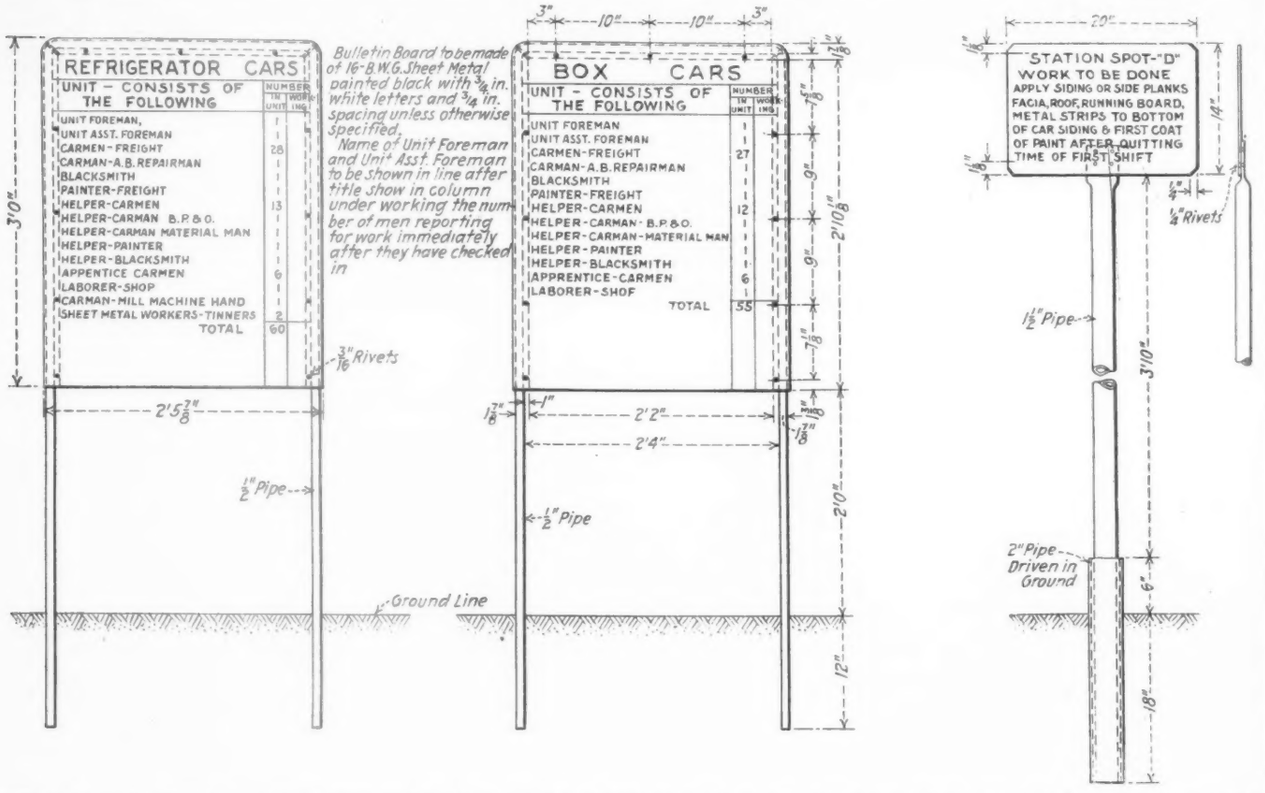
On repair tracks where the oil furnace is used, it has been found good practice to pipe the oil from main reservoirs to small furnaces which are stationery at each spot. The oil is forced through the pipes by air pressure, which saves the cost of handling it through the shops in small tanks or buckets by hand. This will save a great amount of labor and material in any shop.

Dismantling and assembling

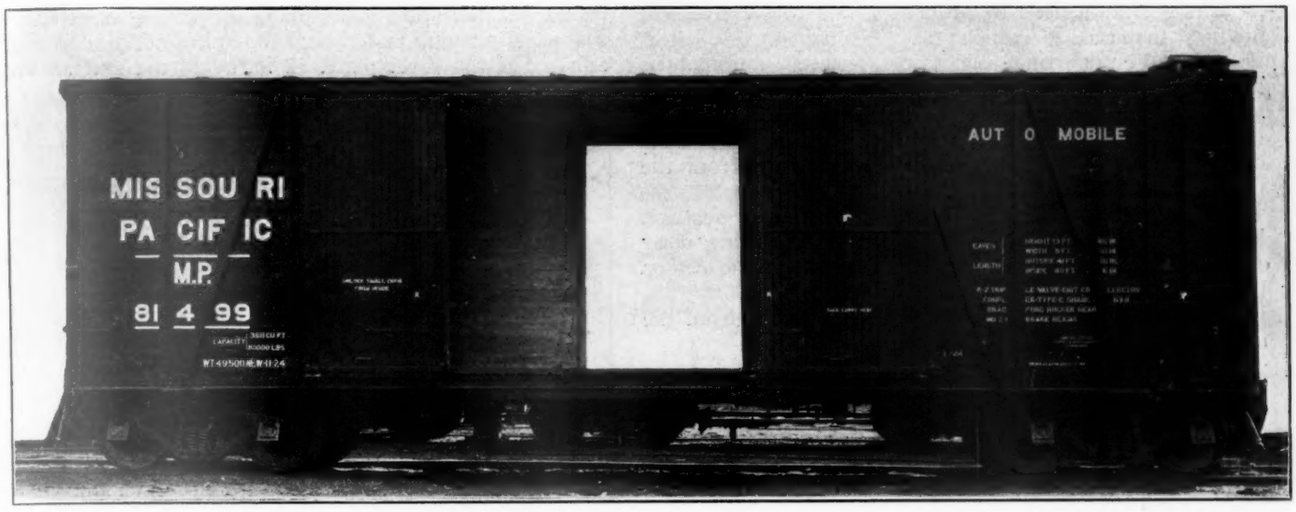
Railroads which are equipped with the modern facilities may obtain a greater output and at much less cost if they have the shop supplied with overhead cranes. A shop of this kind should be equipped with a stripping point, where all the deteriorated parts are removed and scrapped, and the material which may be reclaimed, taken to the various presses and straightened out. It is found worthwhile to have sufficient pressure to straighten the steel car parts cold.

After the car has been stripped it should be picked up by the overhead crane and carried to the point where the sills are repaired and riveted up. The trucks should then be taken to the last spot, where they should be rebuilt and put in first class condition. The sides of the cars should be fitted and riveted up on a pit riveter and carried to the next spot, and, by overhead crane, delivered to where the sills have been repaired. Then the entire car should be assembled, and carried up to the next spot, where the riveting should be done, then moved up and the trucks placed under the car. It should then be moved to the next spot, where safety appliances should be applied. The car is then ready for painting, and should either be sent to the paint shop or the spot designated for painting.

Another very important item in repairing steel cars is to have the proper material standard to the car applied, and where shops are furnished with this material, they obtain a greater output with less labor cost. The cost of repairs to steel cars will be very high if an attempt is made to manufacture in the shops which have not the facilities for turning out a finished product, to maintain the supply of material to make necessary repairs to cars.


REFRIGERATOR CARS
UNIT - CONSISTS OF THE FOLLOWING
NUMBER IN UNIT
NUMBER WORKING
UNIT FOREMAN, 1
UNIT ASST. FOREMAN 1
CARMEN - FREIGHT 28
CARMAN-A.B. REPAIRMAN 1
BLACKSMITH 1
PAINTER-FREIGHT 1
HELPER-CARMEN 13
HELPER-CARMAN B.P.&O. 1
HELPER-CARMAN MATERIAL MAN 1
HELPER-PAINTER 1
HELPER-BLACKSMITH 1
APPENTICE CARMEN 6
LABORER-SHOP 1
CARMAN-MILL MACHINE HAND 1
SHEET METAL WORKERS-TINNERS 2
TOTAL 60
Bulletin Board to be made of 16-B.W.G. Sheet Metal painted black with 3/4 in. white letters and 3/4 in. spacing unless otherwise specified.
Name of Unit Foreman and Unit Asst. Foreman to be shown in line after title show in column under working the number of men reporting for work immediately after they have checked in
BOX CARS
UNIT - CONSISTS OF THE FOLLOWING
NUMBER IN UNIT
NUMBER WORKING
UNIT FOREMAN 1
UNIT ASST. FOREMAN 1
CARMEN-FREIGHT 27
CARMAN-A.B. REPAIRMAN 1
BLACKSMITH 1
PAINTER-FREIGHT 1
HELPER-CARMEN 12
HELPER-CARMAN-B.P.&O. 1
HELPER-CARMAN-MATERIAL MAN 1
HELPER-PAINTER 1
HELPER-BLACKSMITH 1
APPRENTICE-CARMEN 6
LABORER-SHOP 1
TOTAL 55
3/16" Rivets
1/2" Pipe
1/2" Pipe
Ground Line
STATION SPOT-"D"
WORK TO BE DONE
APPLY SIDING OR SIDE PLANKS FACIA, ROOF, RUNNING BOARD, METAL STRIPS TO BOTTOM OF CAR SIDING & FIRST COAT OF PAINT AFTER QUITTING TIME OF FIRST SHIFT
1/4" Rivets
1/2" Pipe
2" Pipe Driven in Ground

Bulletin boards showing type of cars undergoing repairs placed at ends of the track on which the unit or force is working

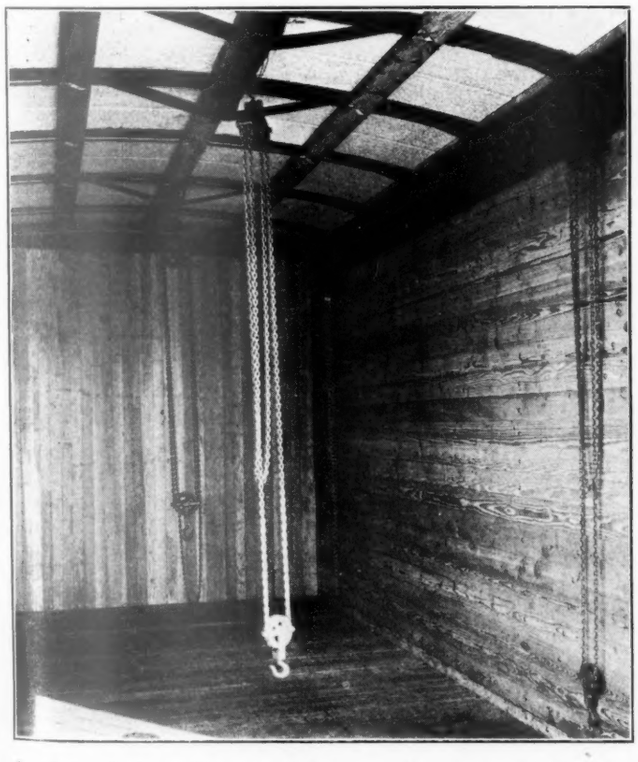


New Missouri Pacific automobile car

Missouri Pacific automobile cars

New design arranged to provide special hoisting facilities—Steel roofs and ends—Large staggered doors

THE steadily increasing movement over the Missouri Pacific of automobiles from eastern and northern factories, and from branch factories and assembling plants at its principal traffic gateways, together with the railroad's policy of providing the most modern equipment for its shippers, resulted in the Missouri Pacific order for 1,000 new 40-ton automobile cars in the latter part of 1924. These cars are now being placed in service. Perhaps their most noteworthy feature is a specially designed hoisting arrangement for loading automobiles within the cars. This arrangement provides both side and center lifting facilities and was devised to meet the most exacting requirements encountered in the shipment of automobiles.



A view of the reinforced T-beam carline sets with hoisting tackle in place at the side and center

The cars are of the steel-frame, single-sheathed type. They are provided with extra thick side sheathing for blocking purposes, staggered doors with 10-ft. clear openings, specially designed Radial all-steel roofs, steel underframes, and Murphy corrugated three-piece steel ends. The cars are 40 ft. 6 in. long, 9 ft. wide and 10 ft. high.

The center hoisting facilities consist of four steel T-beams fastened to reinforced steel carlines of sufficient strength each to carry a load of 2,000 lb. in addition to the roof construction. There are five carlines which are not needed for lifting purposes.

There is one of the T-beam carline combinations on each side of the doorway, with the first of the series set back 3 ft. 1½ in. from the transverse center line of the car. The other two combinations are at each end of the car. To these steel T-beams the automobile manufacturer fastens tongs similar to ice tongs, to which are then attached block and tackle for raising the automobiles.

In addition, there are 36 steel eyes set in the side plate of the car for side lifting. These are arranged in series, four between the first and second T-beam carline combinations nearest the doorway on each side, two between the second and third carlines of these forward sets, and three on each car side between the ends of the car and the innermost hoisting carline.

Such is the arrangement of the hooks and beams that lifting force can be applied with block and tackle from almost every angle or direction and at any place within the car. So far as is known, this method has never been used before.

The extra thickness given to a portion of the side

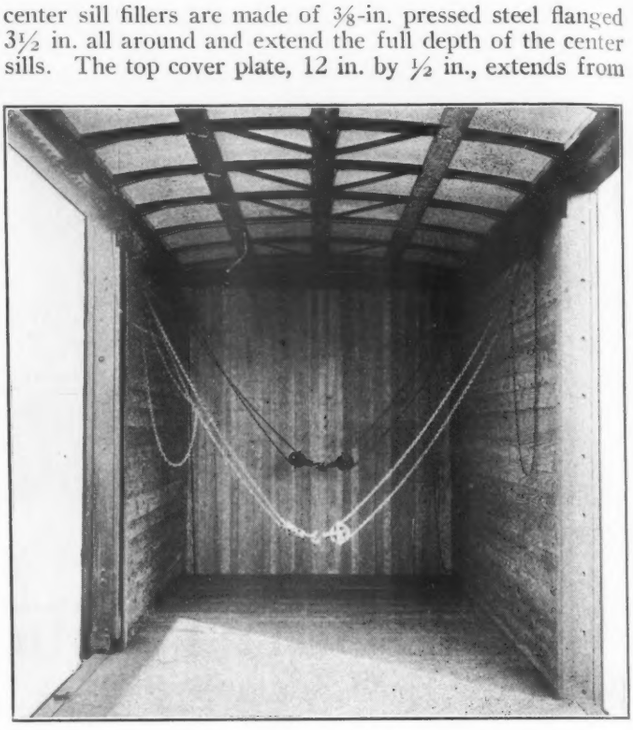
sheathing was devised to provide strong and convenient holding material to which may be nailed, or bolted, blocks for supporting platforms between automobiles loaded on others beneath them. This desired thickness was obtained by applying six tongued and grooved boards, 2 in. thick, with a face of 5¼ in., one above the other, beginning at a height of 3 ft. 3¾ in. from the floor.

The 10-ft. clear door opening, with the stagger feature, is obtained by making the larger side door with a clear opening of 6 ft., or 3 ft. on each side, from the center line of the car, and locating the smaller door, 4 ft. 1⅜ in. wide, on the left side when facing the door from the outside.

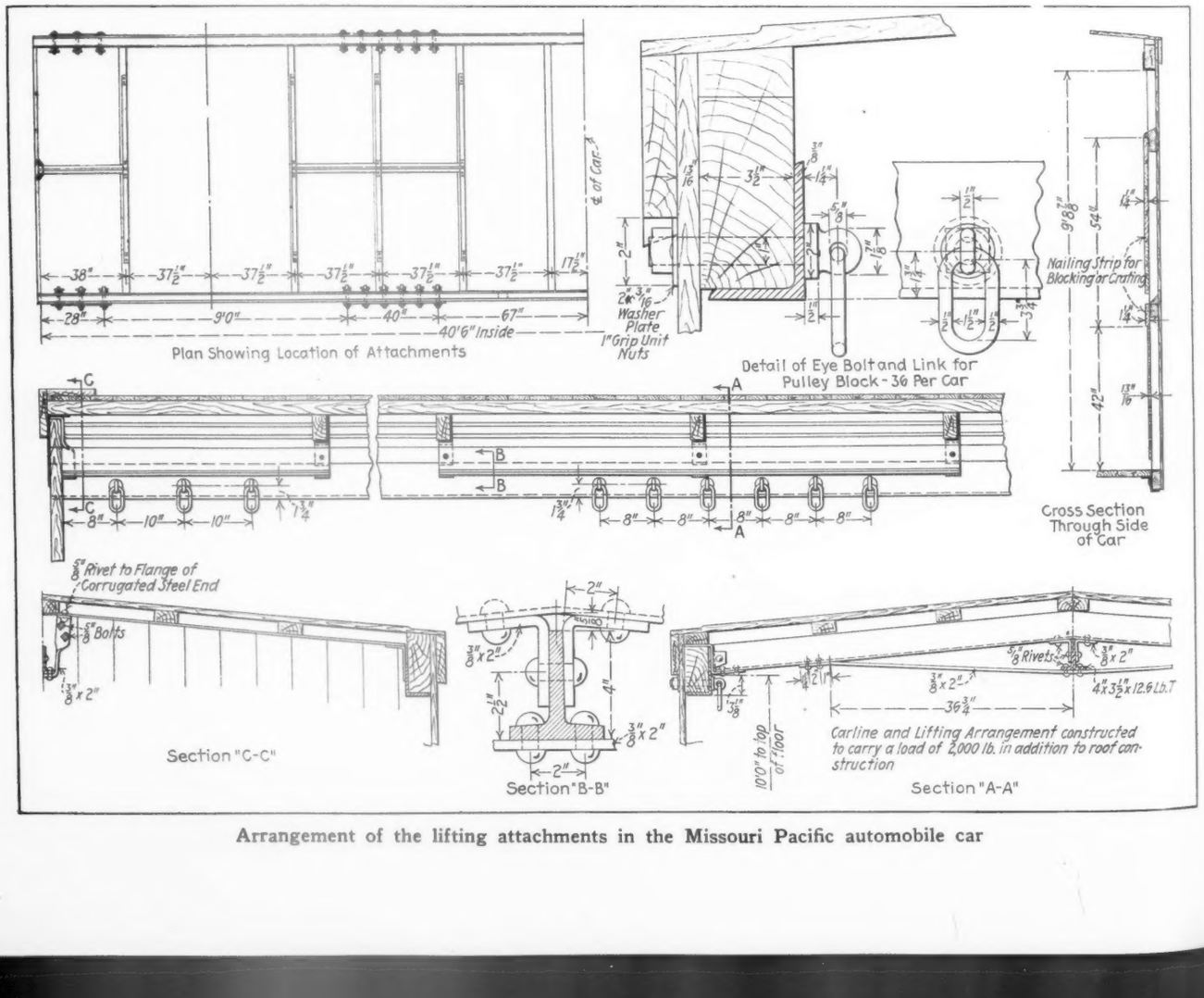
Important construction details

The center sills for these cars consist of two 12-in., 35-lb. channels, spaced 12⅞ in. apart, extending from end sill to end sill with a 20-in. by ⅜-in. top cover plate and a 3½-in. by 3½-in. by ½-in. lower chord angle extending between the bolster filler castings. The specifications call for a cross-sectional area of the center sills of not less than 28 sq. in. The side sills are of Z-bar construction, reinforced at the side doors with a 4-in. by 8.2-lb. Z-bar riveted to the bottom flange and extending 12 in. past the door opening. The body bolster is of box section, having ⅜-in. pressed steel diaphragms flanged 3½ in. all around and placed 11 in. back to back. Top and bottom cover plates extend from side sill to side sill. A diaphragm stiffener of 7/16-in. steel plate is applied at the side bearing.

There are two cross-bearers of 5/16-in. plate flanged 3½-in. all around and reinforced at the top and bottom by 3-in. by 2½-in. by 5/16-in. angles. The cross-bearer center sill fillers are made of ⅜-in. pressed steel flanged 3½ in. all around and extend the full depth of the center sills. The top cover plate, 12 in. by ½ in., extends from side sill to side sill and the bottom cover plate of the same section extends from side to side of the car and is riveted to the side Z-bars.



Tackle in place for side lifting


Plan Showing Location of Attachments
Detail of Eye Bolt and Link for Pulley Block - 36 Per Car
Cross Section Through Side of Car
Section "C-C"
Section "B-B"
Section "A-A"
Carline and Lifting Arrangement constructed to carry a load of 2,000 lb. in addition to roof construction
Nailing Strip for Blocking or Crating
5/8" Rivet to Flange of Corrugated Steel End
5/8" Bolts
5/8" Rivets
40'6" Inside
9'0"
100" to top of floor

Arrangement of the lifting attachments in the Missouri Pacific automobile car

A. R. A., Type D, cast steel couplers with 6-in. by 8-in. shanks are used, operation being from the top. The draft gear is of the Bradford rocker type, provided with "G" springs. The cars are equipped with DeRemer-Blatchford side and end ladders and Viloco pressed steel brake steps. The brake equipment consists of Westinghouse Schedule KC-1012 air brakes with double pressure spring type retainers and branch pipe T-bottom outlets. Among the other specialties which are included in the construction are Bettendorf truck side frames with integral boxes and Asco pressed steel lids, Miner rolling rocker side bearings, Chaton fibre dust guards and Schaefer forged three-hole bottom connections and self-locking brake hangers.

Analysis of causes and remedy for hot boxes*

Co-operation in maintenance and the intelligent selection of lubricants are important preventative measures

By M. L. Harger

General foreman, car department, Pittsburgh and Lake Erie, Newell, Pa.

IT is well said of those charged with the maintenance of railway rolling stock that there is always a subconscious dread hovering about them of a hot box epidemic breaking loose like a bolt from a clear sky just about the time they think all is going well.

We are all familiar with the usual method of combatting the menace, i.e., tightening up on inspection, whereby more journals are jacked for inspection and more new bearings applied on account of being worn, cracked, or squashed out, so-called conducive elements corrected; more oil is used and more attention given to the treating of the boxes usually resulting in some relief but never completely subduing the hot box, which is conclusive evidence of something basically wrong.

I am in strong accord with the car foreman who stated, "I sincerely believe that with proper and general co-operation in the maintenance of all parts in this connection, that a 50 per cent improvement in results and savings can be made," but after the 50 per cent improvement has been made, you still have some hot boxes. If you follow the same principle to all the "leads" pertaining to the hot box, we should conquer them completely. This is the underlying principle with which I wish to deal in this article.

Eternal vigilance is said by many to be the keynote to successful hot box prevention. By constant vigilance you can keep within certain limits, according to the class of cars and business handled, the full tonnage car being the real trouble, such as those handled in ore, limestone, coal, etc. In such trade where those concerned become a little negligent, it is not uncommon for hot boxes to reach five per cent in the first 100 miles. Careful attention by the inspectors and oilers will bring it down to two per cent, possibly in some cases a little lower.

We often hear the matter referred to as a broad question. It is. But how little the fundamental principle of friction and lubrication is understood by the masses performing the important phases of the different operations to the completed journal under a car. You have only to approach the majority of them, and here again you are back to the foreman who said, "I sincerely believe that with proper and general co-operation in the maintenance of all parts in this connection, that a 50 per cent improvement in results and savings can be made."

After you have corrected all the faults of your yard practice of inspection and treatment which calls for eternal vigilance, you cannot overcome in the transportation yard faulty babbitt, faulty oil, faulty waste, faulty journal turning, etc. These are the underlying faults against which the car repair foreman, his inspectors and oilers, no matter how proficient, are powerless. The average inspector is familiar with the ordinary items usually attributed as being conducive to hot boxes, such as packing that is out of adjustment or glazed, waste grab, dirt, flat wheels, side bearing clearance, broken and compressed truck springs and missing dust guards. After correcting all items known as being conducive to hot boxes, he is at the end of his resources, and his responsibility ceases at this point.

The important items to consider are: the babbitt lining of the bearing, wedge, perfect workmanship and practice in turning journals, good oil and waste.

Reclaimed bearings potential source of trouble

The practice of carrying economy too far in reclaiming journal bearings is the cause of innumerable hot boxes, beyond the control of yard inspection forces.

I will not attempt in this article to draw any conclusions on how far it is safe to go in developing a cheap alloy for lining bearings. Such a paper would be lengthy in itself. The fact is, we have thousands of bearings in circulation, lined with poor alloy which is as detrimental to the service as bad money in circulation. And the greater fault lies with the railroad company that will take an alloy that has caused a hot box, melt it, and reline another bearing with it to cause more trouble, or perhaps melt it with a good alloy and depreciate the value of the whole batch.

The practice of relining journal bearings with so-called babbitt metal reclaimed from all sources without first ascertaining by analysis what it is composed of, is mechanically unsound. It should be analyzed, and where it does not come within set limits, make it so by the addition of the necessary elements to make the standard alloy; then and then only, is the babbitt as good as new.

The practice of having the relining done by men abso-

*A paper submitted in the competition on hot box prevention which closed March 1, 1924.

lutely ignorant of metallurgy, at least within the limits of the metal they are handling, is bad. Such ignorance is the cause of many hot boxes where all other elements were 100 per cent.

While I do not wish at this time to go into details of bearing alloys, I will say I am of the opinion that lining bearings with plain lead and antimony is bad practice, because with little variation of antimony, you obtain a poor alloy. If too little is added, the alloy will become plastic and will readily squash out like dough under a rolling pin. If too much is added, it will crack readily and break away from the shell, and above all, with the slightest failure of the oil, the journal and bearing will abrade each other more readily than other alloys, and when once it grips the journal its destruction is very rapid. This causes a dangerous condition in transit, as such bearings will not respond to temporary treatment intended to carry the car to a terminal, thus necessitating setting the car out at once or taking grave chances on hauling it to a terminal.

Care in selection of oil and waste is important

Proper oil and waste for lubricating journals is of major importance to abolish the hot box, and the same principle applies to oil and waste as to bearing alloy. By far too many accept without question the thought that any kind of alloy termed babbitt is all right or that any form of oil will answer the purpose.

As the use of reclaimed babbitt of unknown content is bad practice, and mechanically unsound, so is the use of reclaimed oil of unknown viscosity, gravity and content.

Many hot boxes are caused by foreign substances in reclaimed oil which will gather along the edge of the bearing until it acts as a "wiper" or works its way into the bearing, forming a carbon coating, absolutely void of any friction absorbing quality, resulting in the gradual heating of the journal. Such heated journals, if caught in time, can be flooded with good oil and if the paste has not formed a hard coating, it is safe to proceed, or the bearing can be cleaned, oiled and replaced. This is the slow developing hot box, very common to the car man, and is the kind of hot box that, if it occurs to a journal in transit having a good babbitt lining on the bearing, can be nursed for quite a long distance by the train crews without much difficulty, and will in time cool down under proper treatment and give no further trouble. The same ignorance usually prevails around the oil reclaiming plant as that associated with reclaiming babbitt and relining bearings, whereby, questionable oil is put in circulation, just as sure of causing trouble as the bad babbitt. The theory of lubrication and the theory of friction and chemical properties of oil is unknown to the average dope reclaiming plant.

The reclaiming of oil is a necessary conservation of the oil supply as well as an economy to the railroads. But in order to make it a real economy, it must be done right.

Oil should not be reclaimed in a back yard plant of every division by inexperienced men, but at a well equipped central point, supervised by a competent chemist, thoroughly versed in petroleum and the friction the oil is to absorb, as well as the conditions under which it must absorb it. Not a drop of oil, new or old, should be used until it has satisfactorily met laboratory requirements.

Such a plant means an initial outlay of money, but it will soon pay for itself and then pay larger dividends in operating savings than any other efficiency movement on the system, assuring a wonderful reduction in hot boxes and lubrication at a surprisingly low figure.

Closely allied with the oil is the waste, which should be handled the same as the oil and completely renovated, preferably at the same central point as the oil. Old waste should never be used until completely renovated and restored to the same specifications as new waste for dope, having the maximum amount of resiliency consistent with the correct proportion of capillary power. Many hot boxes owe their origin to dead waste which lacks enough resiliency to hold the oil in contact with the journal. The inspector or oiler finding a box where the dope lacks resiliency will pack the dope around the journal as solid as possible, but a few jolts of the car and the action of the journal will pack the dope away from the journal for its lubrication until treated at the next terminal, if it happens to run that far without developing a hot box.

Dope should not be prepared at the reclaiming plant for shipment to car shops in barrels or other containers, but properly reclaimed oil and waste should be shipped the same as new oil and waste to the local point and there made up into dope by an experienced man, according to the demands at that point.

Improper wedges increase bearing pressure

The journal wedge is of major importance in the abolishing of hot boxes, because the wedge is an equalizer of the weight to be carried on the journal. The wedge is well taken care of by the use of A. R. A. standard wedge, and where all the provisions surrounding the A. R. A. wedge are right equal distribution of weight is assured. Where they are not, which is quite often the case, the bearing surface is reduced and the weight per square inch increased to a point above 800 lb. which is bound to develop a hot box, because, while some oil will maintain a lubricating film under 1,200 lb. pressure, the average oil will not. Therefore, too much attention cannot be given the bearing surface of the journal box and the wedge, which if worn very much will give undesirable service and become the source of trouble.

The broaching of relined bearings, if mechanically performed, is good practice, especially where the bearing is to be applied to a loaded car of full tonnage, because here you have a condition subjecting the lubricant to its utmost, where it must lubricate under pressure exceeding in most cases 800 lb. per sq. in., and where the bearing has been broached it has a good smooth surface and increased bearing surface for a start. Seventy-five per cent better service is recorded as the result of broached bearings under loaded cars, which is conclusive evidence aside from the theoretical argument. The broaching of second-hand bearings causes many hot boxes due to proper inspection not being made, whereby cracked lining and otherwise defective alloy is put in service.

Poor journal turning a contributing factor

Not the least of hot box trouble can be traced to faulty journal turning, and is a matter which must be watched with as much diligence as yard and shop practices. The practice of taking a rough cut from a journal and rolling it does not, at its best, give a 100 per cent job, and where care is not taken to make the best possible cut a satisfactory result in operation will not be obtained. The tool should never be adjusted in the middle of the cut, and if exceptional care is not taken with the roller, the journal will have a series of waves; the bearing will bear only on the crest of the waves, causing increased pressure, or the bearing will seat in the waves and the lining be destroyed by the lateral motion.

I believe that the day is not far off when the A. R. A. will incorporate into the rules for billing foreign car owners, such provisions as will assure the application of bearings lined with a babbitt metal of known good content, oil of known viscosity and gravity, free of all foreign substance, and good clean, live waste of proper resiliency and capillary power, in order to justify billing.

In closing, there is one reliable method of combating the hot box, and many of the other difficulties in railroad operation. That is knowledge—knowledge of existing facts at the time of their existence, not a month or more later.

This of course is recognized by many of our railroads and practiced to some extent by many, but in most cases in a disorganized haphazard fashion. On many roads the old-fashioned theory of keeping everybody in ignorance is still in vogue. Nothing can be gained by, or is more harmful than, dissimilation of conditions. Meet any condition full in the face, meet a fact with a fact, conquer or be conquered. Armed with the mechanical theory, full knowledge of all existing facts, you can overcome an epidemic of any kind.

In order for a foreman to have these weapons he must chart his operations, know at a glance when they are good, and be able to see at a glance the first indication of something going wrong; immediate investigation will correct the matter before an epidemic starts. The foreman cannot keep his chart up to the minute without the cooperation of the divisional officer over him, who should keep him well supplied with the information he cannot gather locally. On the hot box question he should be furnished promptly with the initial and number of every car having journal failure leaving his point, together with inspection pass marks, and the opinion of the foreman under whose jurisdiction the repairs were made.

Every department should have its intelligence department, which should gather all facts, analyze all failures, have experts to cover certain fields of operation, to school the inexperienced and correct the faults, furnish the foreman promptly with information pertaining to failures in certain lines; just as the laboratory is essential to the manufacturer of steel, so is the intelligence department essential for successful operation of the railroads. Without the laboratory and chemist, the steel manufacturer would be ruined by the bad steel manufactured before he corrected the fault. Without the intelligence departments the railroads will have epidemics and failures of various kinds which they will not understand. Take your choice.

American Refrigerator Transit buys new equipment

Modern features of design are incorporated in large order of new refrigerator cars

LAST September, the American Refrigerator Transit Company, a private refrigerator car line owned jointly by the Missouri Pacific and the Wabash, divided an order for 2,000 refrigerator cars among the American Car & Foundry Company, the Mt. Vernon Car Manufacturing Company and the General American Car Company and the work of constructing these cars is now practically completed. They embody the most serviceable features developed over a long period of years.

The cars, built with steel underframes, are 39 ft. 9 in. long; weigh 58,000 lb., and have a capacity of 80,000 lb. They are equipped with the basket type ice bunkers having a capacity of 10,500 lb., and insulated bulkheads. These ice baskets are made of heavy galvanized wire

The new A. R. T. refrigerator car

netting and are suspended in the bunkers in such a way as to allow about two inches of space between the netting and the walls of the car on all four sides. This gives a free circulation of the air, allowing it to come in contact with the ice on all four sides and causing much more rapid refrigeration than could be obtained otherwise. The insulated bulkheads result in a better circulation of cold air through the car. Each bulkhead is insulated so as to allow no infiltration of air except at the top and bottom, there being an opening of about 12 in. at both places. The warm air entering at the top of the bunker comes in contact with the ice and passes out at the bottom opening. On account of the limited open space at the bottom of the bunker, the cold air of its own pressure is carried all the way to the center of the car, circulating freely under the floor racks and touching all parts of the load.

The floor racks in question are hinged to the side walls so that they may be raised to permit a thorough cleaning of the car floor. The use of these floor racks gives a more thorough circulation of the cold air under the load as well as a protection from excessively low temperatures by keeping the commodity off the floor proper. They also allow the warm air, where cars are moving in heater service, to circulate under the load.

The cars are equipped with No. 22 gage metal roofs of the Murphy X L A type. The underframe is of the fish-belly type and the trucks have cast steel side frames and cast steel bolsters. The roof insulation consists of 2½ in. of Hairinsul, the floors 2 in. of Hairinsul in addition to the double flooring, and the air space and the side and end walls consist of 1½ in. of Hairinsul and two layers of Celotex, each being ½ in. thick.

Special attention given to insulation

Between the stringers is placed a false floor on which is laid two inches of insulation. A ⅞-in. tongue and grooved floor is laid on the stringers and over this is spread a layer of waterproofing asphalt, the regular 1¾-in. flooring being placed on top. Waterproofing material is also poured between the framing on the sides and ends to prevent water seeping through. This waterproofing material meets a rigid specification so that it will stand up under extreme heat or cold. In addition to waterproofing the floor, the insulation in the walls is covered with a layer of waterproofing paper in order that it may be kept dry and retain its efficiency as an insulating medium.

Celotex, which is comparatively new in the field of refrigerator car insulation, is made from the pulp of sugar cane, thoroughly ground and the fibres interlaced and pressed into boards ½ in. thick and of any desired size. It is much lighter than lumber and its insulating value is approximately three times as great. In these cars, Celotex has replaced the sheathing, both inside and outside of the framing, reducing the weight of the car approximately 4,000 lb. Celotex also adds to the rigidity of the car body because it is applied in large sections the full height of the car, so that its diagonal strength is much greater than that of lumber.

Ten of these cars are being insulated with Dry Zero, a product of the Johns-Manville Company, which is comparatively new in the refrigerator car field. This material has already been applied in a few cases but the application in these cars is different from any previously made. In the past, it has been applied entirely in bulk, packed between the framing, but in this lot of cars it is applied in blanket form in the side and end walls. A blanket of the material two inches in thickness and sewed between layers of burlap is applied on the outside of the framing between the sheathing and car siding. In the roof and floor, four inches of Dry Zero is compressed approximately 40 per cent, being packed between the floors and between ceiling and roof.

Fifty of the new American Refrigerator Transit cars will be equipped for passenger train service and will be known as express refrigerator cars. They will be 50 ft. in length, equipped with heating and lighting systems, metal bulkheads, etc. The other cars will be placed in regular refrigerator car service.

Economies effected by insulating train steam pipes*

By William N. Allman

General Railroad Department, Johns-Manville, Inc., New York

ECONOMY in operation and conservation of fuel has been the subject of considerable discussion during the past few years in locomotive operation and at the present time it is a matter of paramount importance. The conservation of fuel should, therefore, receive careful attention and investigation. There has not been much data presented on the subject insofar as train steam pipes are concerned, and in a large number of cases the railroads have treated this most important subject lightly. In the operation of passenger train equipment there is considerable exposure in the train line; for a ten-car train there would be approximately 500 sq. ft. of exposed surface. If this surface is not adequately insulated there would be a large loss of heat units.

In meeting the necessity for effectively insulating these pipes against loss of heat, the question arises as to the proper material that shall be used, and what is of even greater importance is the thickness of material that shall be employed to secure the greatest economy. There are a great many types of commercial pipe covering on the market at the present time and it is, therefore, necessary to select wisely the proper insulation in order to obtain the results desired. These types may be generally classified under three headings, namely, the laminated, moulded and cellular type.

It should be borne in mind that the efficiency of all insulators varies according to the size of pipe to which they are applied, and according to the temperature of the steam in the pipes and the surrounding air. It is, therefore, apparent that in selecting a covering adaptable for this service, construction, efficiency and durability should be considered. It should be observed that it would be subjected to continuous vibration and under this service every type of covering would not be suitable.

Efficiency is a very important factor, for the reason that the lines which are to be insulated are subjected to extreme changes of temperature and, furthermore, there is a great increase in loss of heat due to the air velocity on the pipes. The efficiency of pipe covering is the per cent saved by insulating a pipe with a certain material of what would be lost if the pipe were left bare or uninsulated. This per cent is obtained by subtracting the heat loss of the insulated pipe from that of the bare pipe and dividing the difference by the heat loss from the bare pipe. Expressed as a formula it would be as follows:

$$E = \frac{A-B}{A}$$

where;
E = Efficiency
A = Heat loss through bare pipe
B = Heat loss through insulated pipe

*Paper presented before the Manhattan Air Brake Club, New York, on December 18, 1924.

The heat losses may therefore be compared directly as follows:

Bare pipes .....100 per cent
Efficiency .....per cent saving
100 per cent — per cent efficiency = loss through insulation expressed as a percentage of bare pipes.

For example, an insulation having an efficiency of 86 per cent allows a loss of only 14 per cent of the loss from bare pipes.

As an example of the increase in heat losses from bare and insulated pipes due to wind velocity, the following will show approximately what is encountered:

Wind velocity, miles per hr.	Percentage of heat loss for bare pipe in still air	Percentage of heat loss for insulation 1 in. thick
5	155	21.0
10	260	26.0
15	335	28.2
20	397	29.6
25	450	30.6
30	493	31.2
40	562	32.1
50	610	32.7
60	648	32.9

The above table indicates what effect velocity will have on losses and, on bare pipes, it will be noted this mounts up very rapidly. The table as prepared is for a very high-grade of pipe covering. For other materials the losses would be greater in about the same proportion that their rated losses are greater. These values are necessarily only approximate but give an idea of what these particular losses amount to.

Three types of insulation discussed

Not all pipe coverings can be termed good insulation, some being efficient at low pressures, but very inefficient at higher pressures. Some coverings are fairly efficient when first applied but soon deteriorate and do not maintain their efficiency, while others maintain their initial efficiency indefinitely. The underlying principle of efficient insulation is confined to dead air cells, and perhaps one of the best forms of pipe covering is that of the laminated type, which consists of a number of layers of felt composed of asbestos fiber and particles of finely ground spongy material, this combination forming an extremely cellular felt. These layers of felt, being built up in laminated form, confine a large volume of minute dead air cells between the layers, and the general construction makes it a highly efficient covering and one that is most durable as well as maintaining its efficiency indefinitely.

Speaking in general terms of insulation, the next best form, perhaps, is the moulded type of insulation, which is a light, highly efficient insulation. In this type of covering there is also a large number of microscopically small dead air cells. These cells cause the air to become stagnant, and thus a very poor conductor, thereby increasing the efficiency. This particuar form of pipe covering, however, is not as adaptable to service on train pipes as is the laminated form, because of the constant vibration already referred to soon has a tendency to disintegrate the covering.

The next best classification would be that of the cellular type. In order to give an approximate idea of the saving which would be obtained from the various types of pipe insulation on a comparative basis on covering of a known efficiency, I will designate for the sake of convenience three types, known as A, B and C, all 1 in. thick.

A—Laminated form.
B—Cellular type, corrugations running around the pipe, not parallel with pipe.
C—Layer form with indentations in layers.

The efficiency of these coverings for a 2-in. pipe and for the temperature difference dealt with hereafter, are as follows:

A—85.84 per cent.
B—82.00 per cent.
C—78.60 per cent.

For our investigation we will consider a 10-car train, each car having 80 ft. of 2-in. pipe, which is equivalent to 500 sq. ft. of radiating surface. Train line pressure 50 lb., outside temperature 20 deg. F. above zero. The calculated results would run as follows:

Loss in B.t.u. per hour, per sq. ft. bare pipe	1,070
Total radiating surface, sq. ft.	500
Total loss in B.t.u. per hour	535,000
Hours of service per day	16
Total loss in B.t.u. per day	8,560,000
Temperature of steam in train line at 50-lb. pressure	334.3 deg.
Outside temperature	20.0 deg.
Temperature difference	314.3 deg.

Assuming coal to have a thermal content of 10,000 B.t.u. which is very conservative, this would be equivalent to 856 lb. of coal per day loss, or at $4 per ton we would have $1.71 loss per day from bare pipes.

The saving per day effected by using the three types of covering which have been described would be as follows:

Type of covering	Efficiency	Saving per day
A	85.84 per cent	$1.47
B	82.00 per cent	1.40
C	78.60 per cent	1.35

The initial cost of the covering would soon pay for itself and the saving of wasted heat units and ultimate dollars and cents would soon amount to a considerable item. The temperature of steam in a train line of 334.3 deg. F., as covered in the above analysis, is obtained from the following formula:

Temperature of steam (saturated) at boiler pressure of 200 lb. per sq. in.	338 deg. F.
Total heat in saturated steam at 200 lb. per sq. in.	1,199.2 B.t.u.
Total heat in saturated steam at 50 lb. per sq. in.	1,178.5 B.t.u.
Difference	20.7 B.t.u.

Since the change through the reducing valve has been a constant heat change, that is, no work done and no heat gained or lost, the heat in steam at 50 lb. per sq. in. above normal saturation content must be in the form of superheat. Therefore:

$$H_t = S\,(T_s - T_n)$$

Where:
H_t—Total heat above saturation heat content
S—Specific heat of superheated steam
T_s—Highest temperature of superheat
T_n—Normal temperature of steam at pressure given

Therefore:

$$H_t = 20.7 \qquad S = .57$$

Substituting:

$$20.7 = .57\ (T_s - T_n)$$

$$\text{or } (T_s - T_n) = \frac{20.7}{.57} = 36.3$$

$$T_n = 298.0$$

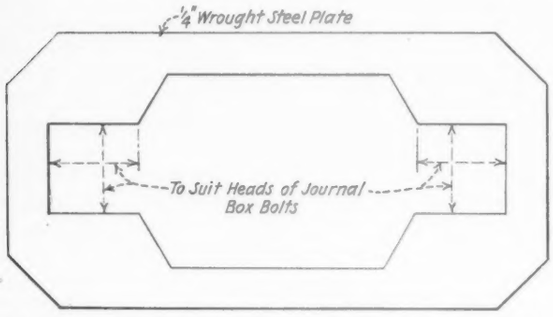
$$\text{or } T_s = 298.0 + 36.3 = 334.3$$

The above conditions and analysis may be considered normal, and results would vary with temperature conditions. For example, in certain sections of the country during the winter the temperature would be much lower than that considered above, also, as the velocity of train increases the loss is greater and as the foregoing is based entirely on still air conditions, the saving would be even greater and more so by using the best insulation, or that having the highest efficiency.

A handy device for the truck repair man

A SIMPLE device for holding the heads of journal box bolts while removing or tightening the nuts, is shown in the sketch. It is made from ¼-in. steel plate. The outside edge and center opening can be readily formed with a cutting torch. The holes for the bolt heads should be

cut square and provide a reasonably close fit to hold the bolt securely. The car repair man places the plate on the top arch bar so that the heads of the journal box bolts fit



A device which eliminates an extra wrench and holds both journal box bolts while the nuts are being removed

into the slots. The nuts can then be applied or removed without any liability of the bolts turning.

Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

Second application of journal bearings on different roads comprising the same system

On December 15, 1922, the Oregon Short Line applied a journal bearing to C. B. & Q. car No. 132,798 at journal box location L-4. The charge was reported on the billing repair card which was included in the audit bill of the car owners. On December 25, 1922, the Union Pacific applied a journal bearing to the same car at the same journal box location and the charge made on the billing repair card was included in the audit bill to the C. B. & Q.

On December 9, 1922, the Oregon-Washington Railroad & Navigation Company applied a journal bearing to C. B. & Q. car No. 98,944 and included the cost of repairs in their audit bill using a Union Pacific billing repair card. On December 12, 1922, the Oregon Short Line applied a journal bearing to the same car at the same journal box location and the charge was reported on the billing repair card which was included in the audit bill. The charge for a prior application on the Oregon Short Line, November 22, 1922, to the same car, same journal box location, was included in their audit bill on a Union Pacific billing repair card.

Claims presented by the C. B. & Q. to the Union Pacific for cancellation of one or more of the charges was declined by the Union Pacific on the grounds that such applications of journal bearings were made by separate railroad companies, and, therefore, Rule 99 did not apply to these cases. Insofar as Interchange Rules are concerned, the Union Pacific is comprised of four subsidiary companies which should be considered as individual railroads.

It was contended by the Union Pacific that the four subsidiary lines commonly known collectively as the Union Pacific System are separate units, under the laws of the United States, and therefore, also under the Interchange Rules of the A.R.A. The Union Pacific substantiated this statement by giving eight reasons why the four units should be considered as separate railroads.

The C. B. & Q. contended that so far as Rule 99 was concerned, the several units of the Union Pacific System should be considered as comprising one and the same road and not as individual foreign roads. Therefore, when a foreign car has a journal bearing applied and charged for on two or more of the units of the Union Pacific, such charges should be subject to the provisions set forth in the rules.

The Arbitration Committee in rendering a decision in this case, stated that: "In view of the status of the four roads in question with regard to their relation to the Union Pacific System as explained by the Union Pacific, they are properly considered as separate roads in application of Rule 99. Therefore, the contention of the C. B. & Q. is not sustained."—*Case No. 1319, Union Pacific vs. C. B. & Q.*

Responsibility for damaged car offered in interchange

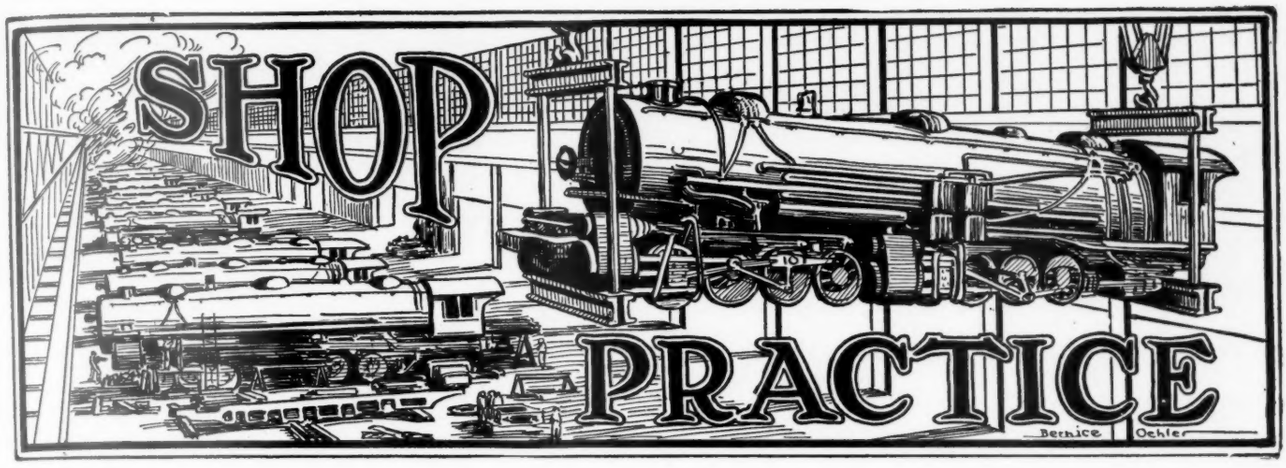
Pierce Oil Corporation tank car No. 2393 was wrecked in derailment at Randolph, S. D., and damaged to such an extent that it was necessary to load it on a flat car for movement to the Minneapolis shops of the Minneapolis & St. Louis for repairs, and on March 22, 1922, the owners were advised of its release for service. The car was moved home to Sand Springs, Okla., via Minneapolis & St. Louis to Wabash at Albia, to M.-K.-T. at Kansas City, to Sand Springs Railway at Home Junction for delivery to the owner. On April 11, the day after delivery, a joint inspection was made, on the basis of which the car owner contended that a number of defects had been left unrepaired and that in some cases wrong material had been applied. The Minneapolis & St. Louis stated that there may have been a possibility of other roads which handled the car from the time it left its Minneapolis shops until delivery to the owner contributing to damage en route. It also stated that defect cards for wrong repairs as claimed had been furnished, but refused to furnish cards for the other items, being of the opinion that it was not responsible, in view of the fact that the tank was put in good condition before leaving the shops and had passed inspection points without exceptions.

The Arbitration Committee, in a decision rendered February 15, 1924, decided that, with the evidence presented, the car owner's recourse is against the delivering line in accordance with the first paragraphs of Rules 2 and 4.—*Case No. 1318, Pierce Oil Corporation vs. Minneapolis & St. Louis.*

Responsibility for car damaged in switching

The Michigan Central humped a cut of six cars in the Niles, Michigan yards, February 15, 1923, damaging Midland Valley box car No. 4047 to the estimated extent of $1,000. The Michigan Central claimed that the car was not derailed, cornered, side swiped or otherwise damaged as outlined in Rule 32, but on the other hand failed in ordinary handling owing to the general worn out condition. The car owner claimed that the damage to this car was due to the causes set forth in paragraph *D* of Rule 32 and was the handling line's responsibility.

The Arbitration Committee rendered the following decision: "The car was not subjected to any unfair conditions and, according to Rule 32, the car owner is responsible."—*Case No. 1321, Midland Valley vs. Michigan Central.*



British methods of setting locomotive valves

By F. Norman
London, England

THE operation of setting locomotive valves is one in which the need for accuracy will be self-evident to those interested in this subject. The purpose of this article is to describe the practice of setting valves, adopted by a large locomotive works in England. The fact must first be appreciated that any divergence of lead of the valve, relative to the cylinder ports, from that laid down by the designer, may result in a measure of inefficient working, due to losses of steam, etc.

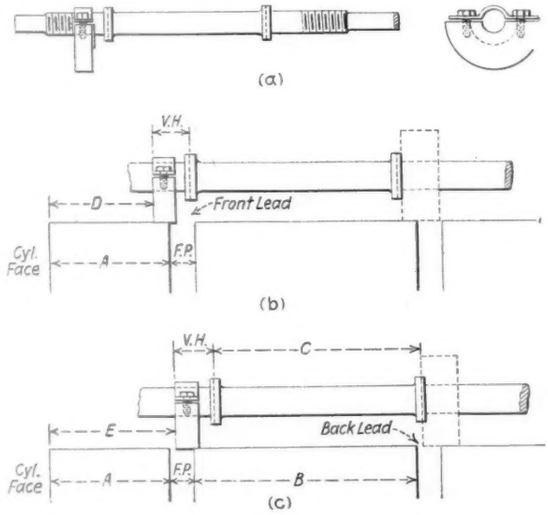


Fig. 1—Dummy valve head and its front and back dead center positions when setting piston valves

Method of setting piston valves with internal admission

The responsibility of setting the valves on all locomotives is in the hands of a mechanic known as the valve setter. He performs his duties at any stage of the erection of the locomotive as most convenient to the progress of the work through the shops. His first step, after the cylinders have been erected with the valve liners pressed in, consists of measuring, by means of a vernier, the position of the ports relative to the front face of the cylinder. These dimensions form the basis of all the valve setting calculations, both when the locomotive is first erected and at any later time when it may be returned to the shops for repairs. A permanent record is kept of these figures for each locomotive. It is well to state that these dimensions almost invariably differ, owing to slight inaccuracies in machining, from those laid down by the designer.

It will be appreciated that, with piston valves a much closer setting is possible than is the case with slide valves for the reason that each valve head is independent of the other and can be adjusted to govern the admission of steam at its respective end of the cylinder. A dummy valve head as shown at *A* in Fig. 1 is used when setting the valves. This is mounted on the valve spindle, the collars of which are left ¼-in. wider than required to allow for the necessary adjustments. Another method adopted in some works is to make the collars according to the dimensions called for by the drawings and then use thin steel washers between the heads and the collars. The objection to this practice is the possibility of the washers either being lost or wrongly assembled, when the locomotive is overhauled, which will alter the leads.

The dummy head is made 1 in. shorter than the valve head. It is placed on the valve spindle, inserted in the cylinder, and the whole coupled up to the valve motion. The engine is placed on the front dead center and then the head is adjusted to its correct position relative to the front cylinder face. Following this, the spindle is removed from the cylinder and put between lathe centers. The collar is then faced up so that a 1-in. setting block will pass between the collar and the dummy head. This will insure that the valve head will be in its correct position when assembled on the valve spindle.

Sketch *B*, Fig. 1, shows the position the valve spindle

and the dummy head should occupy when the engine is on the front dead center. Referring again to sketch *B*, it will be seen that:

D = A + FP — (FL + standard valve head) when,
D = distance of dummy head from front of cylinder.

Take for an example the measurements on a locomotive which show that:

A = 7.998 in.; FP = 1.747 in.; FL = .125 in.; WH = 2.5 in.
D = 7.998 + 1.747 — (.125 + 2.5)
D = 7.120 in.

When the locomotive is on the back dead center:

E = A + FP + B + BL — (C + VH)

Assuming for the moment that the dummy head has been adjusted with the engine on the front dead center to bring the valve head to its desired position, then since the distance *B* between the two ports is fixed, it follows that *C* must also vary in proportion. For example, if *B* is found, after measuring, to be .005 in. wider than as designed, the dimension of *C* should be increased a like amount, for otherwise, the back lead will be increased or decreased accordingly. Thus on the same engine where:

B = 10.505 in. as against the designed 10.500
BL = .250 in.
C = 14 in. according to design
E = 7.998 + 1.747 + 15.505 + .250 — (14.005 + 2.500)
E = 8.995 in.

It may probably be found by the valve setter that after having adjusted his dummy head with the engine on the

Table for Setting Valves - Class Y Engines with Walschaert Valves

Standard Dimensions A=8", B=15.5", C=14", F.H.=2.5", F.P.=1.750, F.L.=.125, B.L.=.250

	Front Port													
	1.747		1.748		1.749		1.750		1.751		1.752		1.753	
A	D	E	D	E	D	E	D	E	D	E	D	E	D	E
7.997	7.119	8.994	7.120	8.995	7.121	8.996	7.122	8.997	7.123	8.998	7.124	8.999	7.125	9.000
7.998	7.120	8.995	7.121	8.996	7.122	8.997	7.123	8.998	7.124	8.999	7.125	9.000	7.126	9.001
7.999	7.121	8.996	7.122	8.997	7.123	8.998	7.124	8.999	7.125	9.000	7.126	9.001	7.127	9.002
8.000	7.122	8.997	7.123	8.998	7.124	8.999	7.125	9.000	7.126	9.001	7.127	9.002	7.128	9.003
8.001	7.123	8.998	7.124	8.999	7.125	9.000	7.126	9.001	7.127	9.002	7.128	9.003	7.129	9.004
8.002	7.124	8.999	7.125	9.000	7.126	9.001	7.127	9.002	7.128	9.003	7.129	9.004	7.130	9.005
8.003	7.125	9.000	7.126	9.001	7.127	9.002	7.128	9.003	7.129	9.004	7.130	9.005	7.131	9.006

Fig. 2—Table for setting valves on a locomotive equipped with the Walschaert gear

front dead center, when he places his engine on the rear dead center and takes his measurement, a discrepancy will be found between the actual and the calculated figures. It is then his object to minimize this difference by dividing the distance between the two centers. Emphasis is laid on the fact that when the front collar on the valve spindle is faced up, the back collar must also be machined to give the correct distance between the two heads. This automatically ensures that the back lead shall be correct.

To eliminate the necessity of making a calculation for each locomotive, a table, as shown in Fig. 2, was compiled, giving at a glance *D* and *E* for all probable variations of *A* and the front port measurements.

Setting the D-type valve

When setting the flat D-type valve a somewhat different procedure is followed. In this case the admission of steam into both ends of the cylinder is controlled by one valve. Sketch *A*, Fig. 3, shows the position on the front and back dead centers respectively. From sketch *A* it will be seen that the distance of the valve from the front cylinder face = *A* + *FL*. In a similar manner

D = A + B — (BL + total width of valve).

As an example, on a certain engine the dimensions for one cylinder were:

A = 13.; B = 8¾ in.; FL = ⅛ in.; BL = ⅛ in.
Total width of valve = 10¾ in.
Therefore:
D = A + FL = 13 + ¼ = 13.250 in.
And also:
D = A + B — (BL + width of valve)
D = 13 + 8¾ — (⅛ + 10¾)
D = 10.875 in.

A table was compiled as shown in Fig. 4 similar to that for piston valves, in which it will be observed that due provision is made for adjustment of the back figures in accordance with any variation of the width of the valve

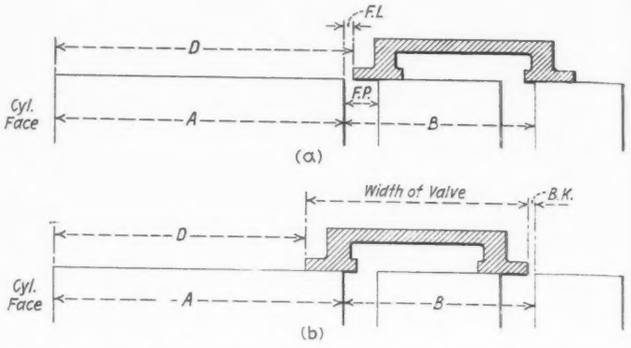


Fig. 3—Front and back dead center positions when setting flat slide valves

from the standard. Thus, for an engine of this class, the actual measurements were found to be:

A = 12.999 in.; B = 8.747 in.; width of valve 10.753 in.

By using the table we find:

Front figure = 13.249 in.
Back figure = 10.868 in.

In the event of it being found that the measurements taken, when the locomotive is on a particular center in the forward gear, vary to any appreciable extent from those taken on the same center but in the reverse gear, adjustment is made by altering the eccentric blades on the Stephenson gear, and the expansion link on the Walschaert gear. In order to reduce the forward gear lead on the Walschaert valve motion, the expansion link carrier is lowered by reducing the thickness of the liners at the bottom and of course substituting a thicker one at the top. A stock of liners is kept, increasing in thickness by 1/32 in. In order to reduce the forward lead, in case of the Stephenson gear, the eccentric blade of the forward eccentric is shortened.

Table for Valve Setting - Class W Engines with Stephenson Valves

Standard Dimensions A=13", B=8.750, Front Lead 1/4", Back Lead 1/8", Width of Valve 10.750"

Front Figures	A	Back Figures B							Width of Valve						
		8.747	8.748	8.749	8.750	8.751	8.752	8.753	10.747	10.748	10.749	10.750	10.751	10.752	10.753
13.247	12.997	10.869	10.870	10.871	10.872	10.873	10.874	10.875	+.003	+.002	+.001	.000	-.001	-.002	-.003
13.248	12.998	10.870	10.871	10.872	10.873	10.874	10.875	10.876							
13.249	12.999	10.871	10.872	10.873	10.874	10.875	10.876	10.877							
13.250	13.000	10.872	10.873	10.874	10.875	10.876	10.877	10.878	Note: Add or subtract the above amounts to the back figures in accordance with the actual width of the valve						
13.251	13.001	10.873	10.874	10.875	10.876	10.877	10.878	10.879							
13.252	13.002	10.874	10.875	10.876	10.877	10.878	10.879	10.880							
13.253	13.003	10.875	10.876	10.877	10.878	10.879	10.880	10.881							

Fig. 4—Table for setting valves on a locomotive equipped with the Stephenson gear

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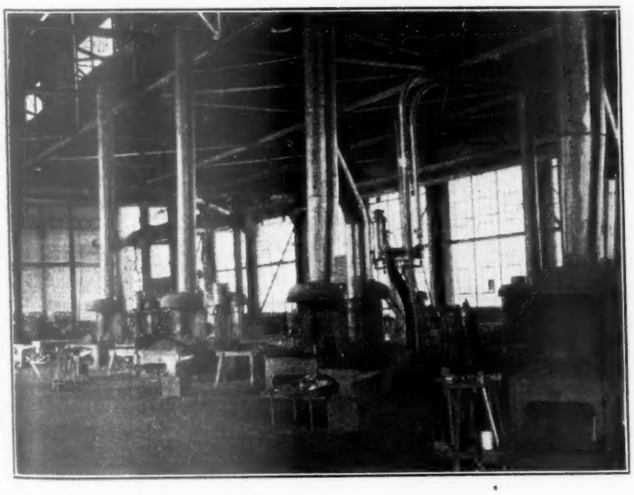
THE SHOP CRAFT EMPLOYEES on the Chicago & North Western have taken a referendum vote on the question whether the co-operative plan introduced on the Baltimore & Ohio and later adopted on the Canadian National shall be put into effect on the North Western. Although the result has not been announced it is expected that the men will favor the plan, since the railway employees' department of the American Federation of Labor strongly advised its adoption. If the adoption of the plan is approved, Capt. O. S. Beyer, Jr., consulting engineer for the unions, who supervised the introduction of the plan on the Baltimore & Ohio and the Canadian National, will make a study of the North Western shops to determine at which point to start the program.

Interior view of the Finley locomotive shops of the Southern Railway, North Birmingham, Ala.

Southern builds modern equipped locomotive shops

Excellent results are being obtained through a system of cost control and inspection

WORK on the first locomotive repaired at the Finley shops of the Southern at North Birmingham, Ala., was completed on October 15, 1924. This locomotive, a Pacific type, was sent into the shops for class three repairs on October 1, 1924, making a total of 13



Interior view of the blacksmith shop

eight-hour working days between the "day in" and the "day out." The total amount of labor and material expended on this locomotive was 40 per cent less than the cost to perform the same work in the old Alabama Great Southern shops at Birmingham, which formerly handled the classified repairs of the Alabama Great Southern, now a part of the Southern System, and the Birmingham division of the Southern.

The repair work of these two divisions was consolidated at Birmingham in 1922. This placed on these shops the burden of maintaining 219 locomotives which eventually required that approximately 20 per cent of the classified repairs be turned over to the shops of other divisions. The working force employed at Birmingham by the mechanical department at that time totaled over 1,500 men. This included the forces employed in both the locomotive and car departments.

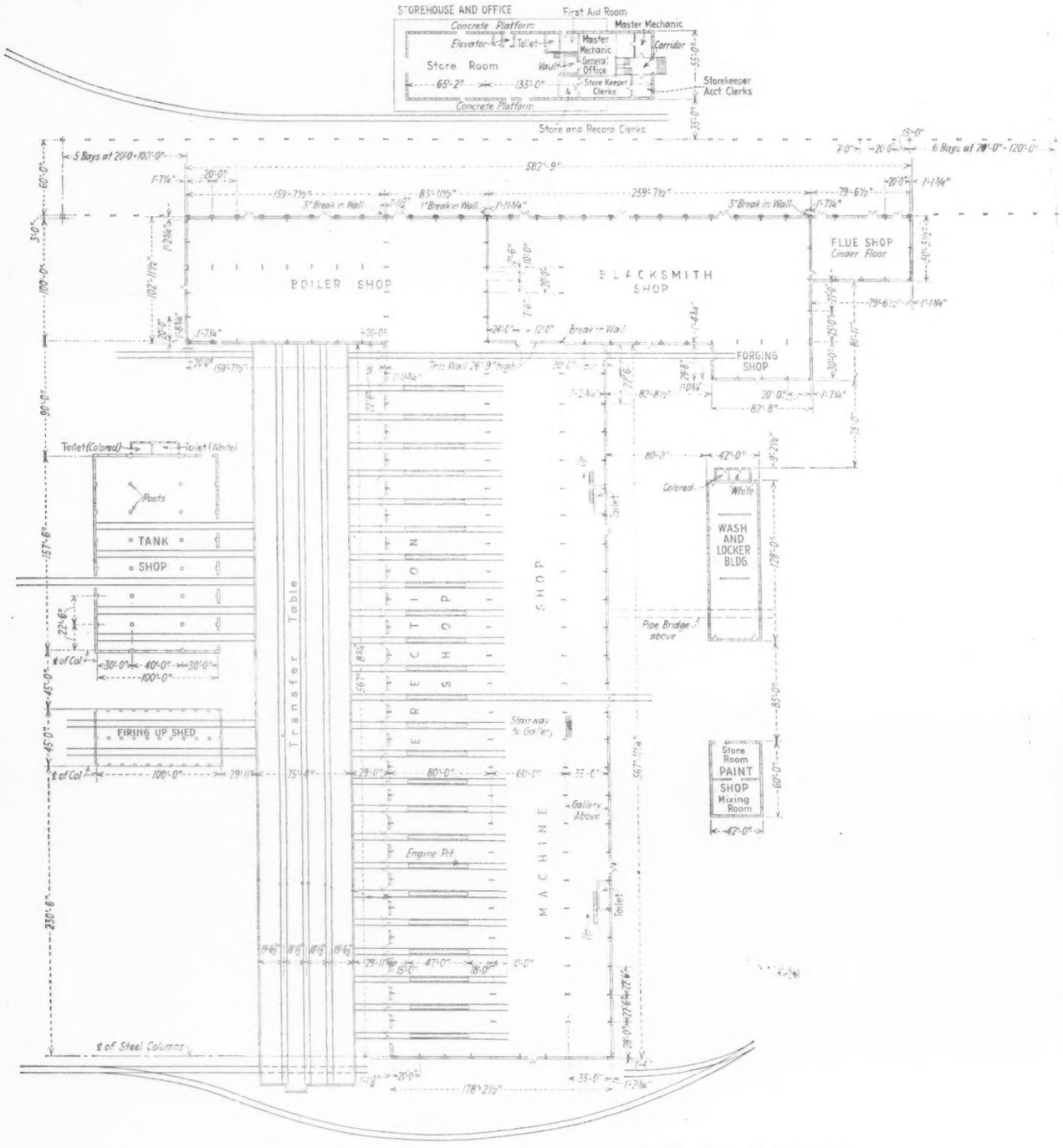
New installation has decreased costs

With the new installation at Finley, the mechanical department was able to reduce the working forces in both the locomotive and car departments to 1,138 men, with a staff of 31 foremen and supervisors and 11 clerks, which includes the day and night forces of the two engine houses. In addition, the locomotives of the Memphis and Mobile divisions, the New Orleans & Northeastern Railroad and the New Orleans Terminal Company, now included in the Southern System, are dependent on the Finley shops for classified repairs, making a total of 466 locomotives.

The Finley installation, named after W. W. Finley, president of the Southern from 1906 to 1913, includes both a locomotive and car repair shop. The locomotive repair unit consists essentially of a T-shaped structure in which are housed a 24-pit erecting shop, and machine, boiler, smith, flue and forging shops. Each shop is laid out for its efficient operation as an individual unit as well as in its relationship to each other. As shown in the floor plan of the locomotive repair unit, the boiler, blacksmith,

forge and flue shops are located in the horizontal arm, while the erecting and machine shops are located in the vertical arm of the "T."

The section containing the erecting and machine shops is 178 ft. wide by 568 ft. long. The erecting shop is of the transverse type with a width of 80 ft. and a clear height of 47 ft. to the roof trusses. The locomotive pits, ft. wide, respectively. The 35 ft. bay is arranged with a gallery floor running the entire length. This floor has landing extensions built out into the crane bay in order that the cranes may be used for handling materials and parts to this floor. The gallery is used for the electrical department, air room, manufacturing tool room, and the tin and jacket shops. The heavy machine tool equipment



Floor plan of the Finley locomotive shops at North Birmingham, Ala.

24 in number, are 47 ft. long. Each pit-track extends 10 ft. into the machine shop area on one side and to a 75-ft. 4-in., electrically operated transfer table on the other. The pit-tracks are 22 ft. 6 in. from center to center.

The machine shop consists of two bays 60 ft. and 35 is located on the main floor. Both the erecting and machine shops have flooring of wood block laid on concrete.

The boiler shop occupies approximately one-half of the section forming the horizontal arm of the "T." The fabricating department of the shop is 100 ft. wide by 240 ft. long, the erecting floor being 80 ft. by 100 ft. The

boiler shop is divided into two bays of 40 ft. and 60 ft. each, the latter bay being equipped with a 20-ton overhead crane.

The blacksmith shop occupies the remaining portion of the horizontal arm of the "T." It is 100 ft. wide by 260 ft. long. Two additions at one end of this shop, house a 50-ft. by 80-ft. flue shop and a 30-ft. by 80-ft. section is utilized for the forging machines. The forge shop is served by a track passing along the outside of the blacksmith shop, through the machine and erecting shops and across the transfer table.

Shop buildings are well lighted

All of the shops are well lighted. A large exposure of steel sash is used in all the side walls and in skylights, monitors and clerestories. Electric illumination is provided by the installation of overhead reflectors with 500-watt lamps spaced approximately 25 ft. apart.

Wash and locker facilities have been provided for in a 42-ft. by 128-ft. brick building located near the machine and forge shops. Toilet facilities have been provided for within the shops, the main installation being on two intermediate or mezzanine floors located in the machine shop, between the main and gallery floors, as shown in the drawing on page 168.

tracks. They are respectively 100 ft. by 157 ft. 7 in. and 100 ft. by 45 ft. in dimensions.

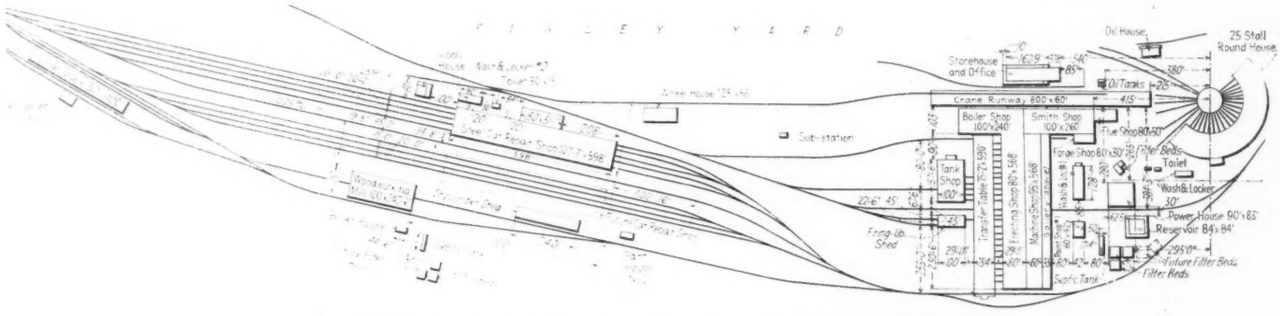
The storehouse and office building—Assembly room for instruction classes is provided

The combined storehouse and office building is a two-story structure of pleasing appearance. One end is devoted to the offices of the master mechanic and division storekeeper and the other to the storeroom. It is of concrete and brick construction with concrete platforms extending across one end and for about three-fourths the length of the building on each side. It is 210 ft. long by 55 ft. wide, the office section occupying approximately one-third of the total length of the first floor and approximately one-fourth of the second.

A large assembly room is also located on the second floor of the office building which provides excellent accommodations for staff meetings, instruction classes and a meeting place for the various shop committees.

A well equipped first aid room, in charge of a trained nurse, is located on the first floor between the offices of the master mechanic and the storeroom.

The space between this building and the locomotive shops is utilized for a casting yard. It is served by a 20-ton crane, one runway of which is carried on the walls of the shop buildings. This craneway is now 800 ft. long

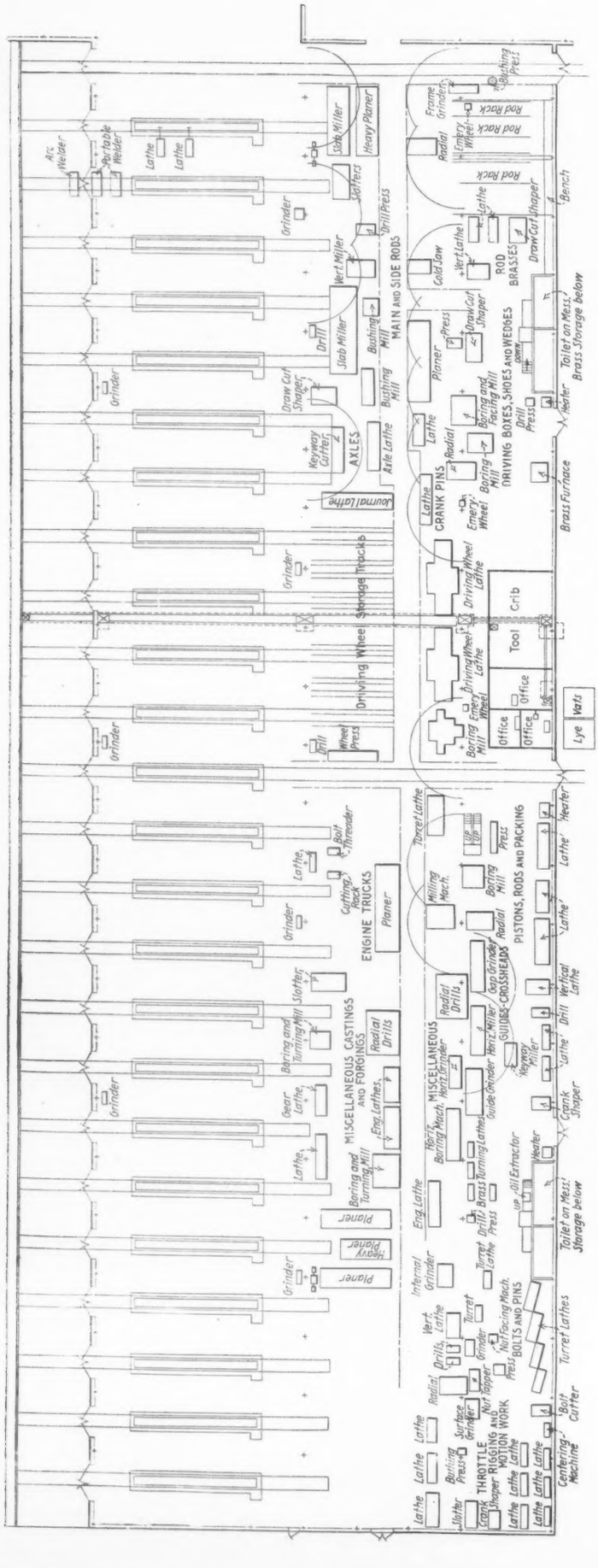


General plan of the Finley locomotive and car shops, North Birmingham, Ala.

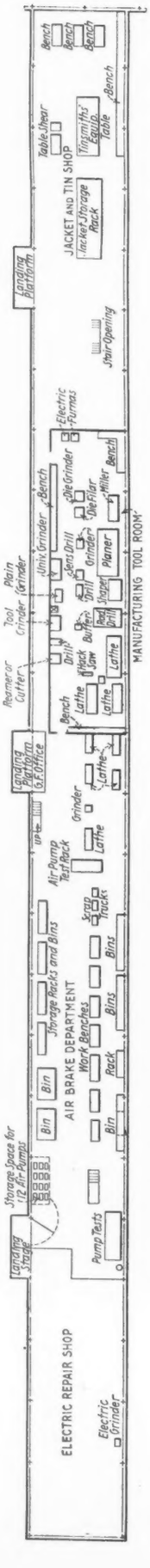
An aeroplane view of the locomotive shops, showing the relative location of the engine house to the machine shop

The location of the various shops has been planned with a possible need for future expansion. Sufficient space has been left to permit another erecting and machine shop to be built on the opposite side of the transfer table. For this reason the construction of the tank shop and the firing up shed now on the opposite side of the transfer table is of a temporary nature. Both buildings are constructed of timber, the former having five tracks, of which one is a through track, and the latter having two but it is planned to extend it so that it will also serve the wheel shop of the car repair unit.

The power house equipment consists of three 420-hp. boilers with stokers and forced draft. Overhead coal bunkers are provided which feed directly to the stokers. Two sets of hoisting equipment have been installed, one for elevating the coal to the bunkers and one for carrying up the ashes from the basement to an overhead bin, which in turn, provides some storage and gravity loading



Floor plan of the machine and erecting shops, showing the machine tool layout



Machine tool and equipment layout of the air brake department, manufacturing tool room and tin shop

into the cars. The air compressor units consist of a 2,500-cu. ft. steam driven unit and a 1,500-cu. ft. motor driven unit. Exhaust steam is utilized in unit heaters which are placed along the walls and along the interior lines of the columns of the various shop buildings. A

A bulletin board showing the principal jobs to be done is hung on each locomotive

turbine generator of 300 kw. capacity has been installed in the power house for use in case of emergencies.

Excellent crane service is provided

One of the features of this installation is the excellent crane service that has been provided for all departments. The erecting shop is served by one 150-ton crane with a span of 77 ft. and two 15-ton overhead cranes with a span of 75 ft. which can be operated the entire length of the unit and into the boiler shop. The 15-ton traveling cranes of 56-ft. span are also provided for the machine shop which can also be operated the full length of the unit and into the blacksmith shop through an opening left in the partitioning wall between the two. Jib cranes have been installed to serve machines that are used for heavy material. A transfer table is provided for the transfer of engines to the erecting shop pits and the firing up shed. The same table also serves the tank shop. The boiler shops and the blacksmith shops are equipped with a full complement of heavy and light overhead cranes for the handling of boilers, hot forgings and heavy parts.

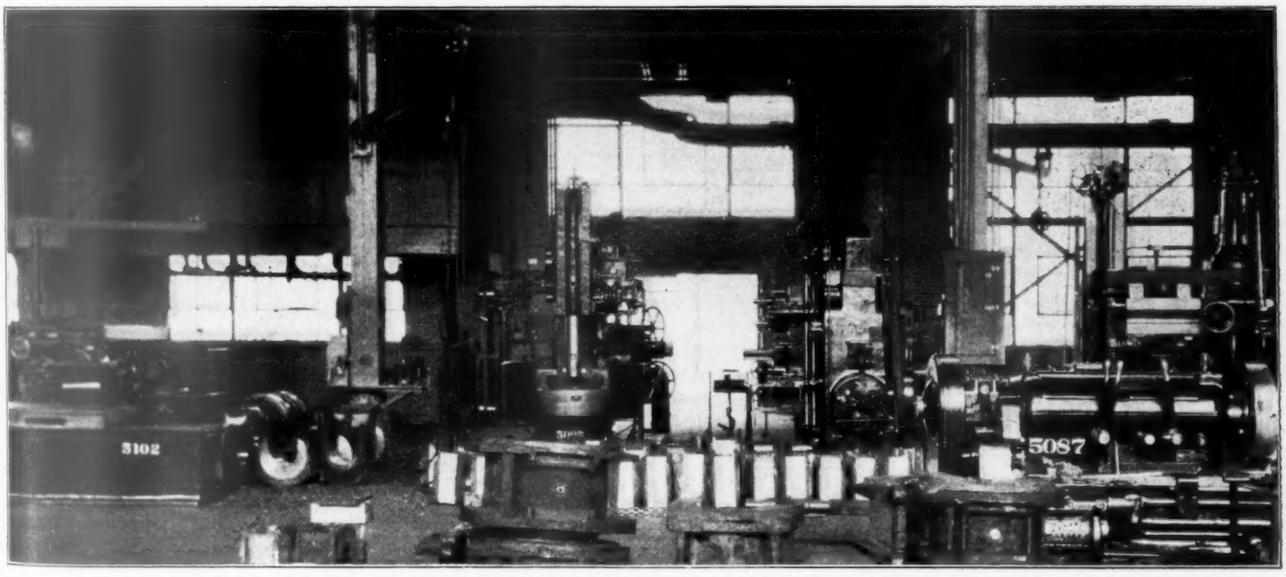
System of handling work in the erecting and machine shops

Only classified repairs are handled in the erecting shop. As soon as a locomotive is brought in for repairs, the wheels are removed and placed on the wheel storage tracks which are located in the center of the wheel shop. Each erecting gang does its own stripping and routes the various parts to the proper departments where they are inspected for repairs or scrapping. The brake and spring rigging are annealed upon arrival at the blacksmith shop and then inspected by the foreman. Valve motion parts, rods, crossheads, guides, etc., are removed by the stripping gang, sent to the lye vat for cleaning and are then routed to the various departments in the machine shop.

A work report of work to be done on each locomotive is sent to the general machine shop foreman by the erecting shop foreman. This report is then analyzed and the necessary instructions are transmitted to each sub-department head, by the general machine shop foreman.

A regular system of shop scheduling has not as yet been installed. However, a careful check is kept on the progress of the work in each department to see that the results correspond to the outgoing date of the locomotives. All material sent to the machine shop for repairs is carefully checked by the head of each department and inspected for limits and standards.

The work of unwheeling and transferring the boilers and cabs to the boiler shop is handled by the overhead cranes. A rack, which is shown in one of the illustrations, has been provided for front end covers. This rack is of sufficient strength to permit its being moved when loaded to capacity by a crane to any place desired. A high platform truck is used in the work of removing super-heater units.



Interior view of the driving box department

Portable engine lathes are used for fitting frame bolts

in the erecting shop. Bolts are drawn from stock, cut to length and are delivered to the bolt department where they are centered on a centering machine. They are then turned to a fit on the small portable engine lathe and then threaded. Considerable attention is paid to the accuracy of these fits and with the lathe located close to the locomotive, it is thought that more satisfactory individual fits can be made, rather than by manufacturing the bolts in quantity to certain standards and then reaming the holes to fit the bolts.

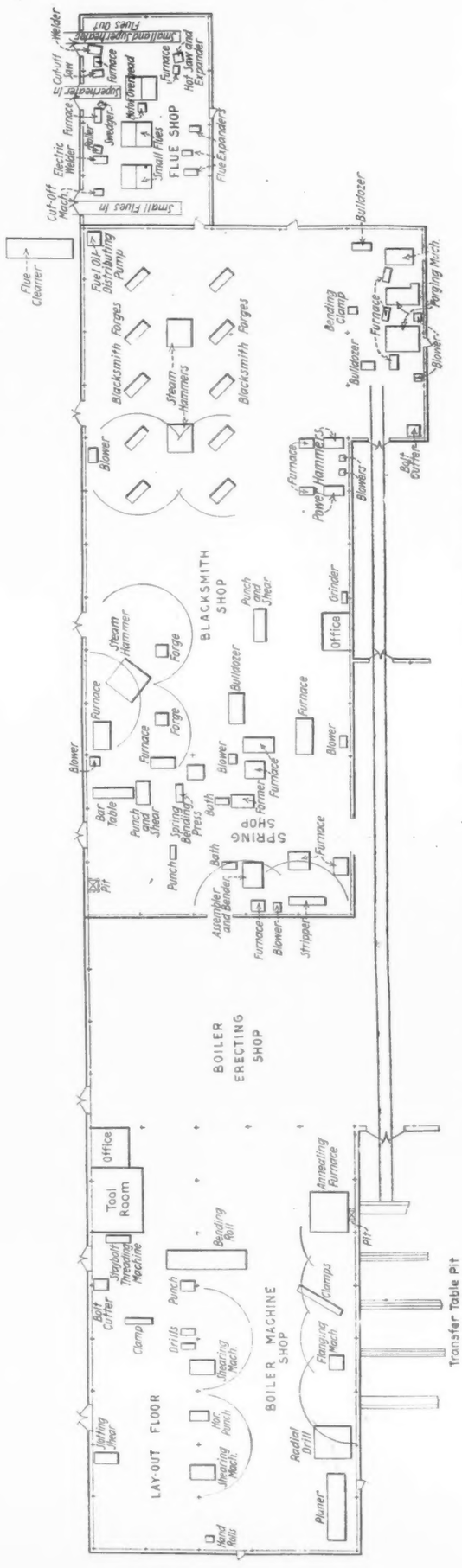
A feature of the supervision of both the erecting and machine shops is the bulletin board placed on each locomotive undergoing repairs. This bulletin board, one of which is shown in an illustration, has space provided for entering the important items of repairs that are being made on the locomotive. The class of repairs is shown at the top of the board. Directly underneath is shown the number of the locomotive and the division to which it is assigned. Four columns for listing the repairs to the machinery, boiler, cylinders and frame are ruled vertically and sufficient space is left at the bottom to show the incoming and outgoing dates. These boards are hung on the end of each locomotive towards the machine bay. The information on these boards enables the master mechanic and his assistants to check immediately the progress of the work on each locomotive and in cases where unsatisfactory progress is shown, to take prompt measures towards improving the situation.

Progress reports are made at weekly staff meetings

A meeting of the supervisory forces is held on Friday of each week. Each department head submits a report of the progress of the work for each locomotive that is being performed in his department. Each foreman, knowing the progress of the work going through the various other departments, can then adjust the work under his supervision so that there will be no delay in the outgoing date of the locomotive from the erecting shop. The success of this system is shown by the fact that there have been comparatively few variations from the outgoing dates originally set since the Finley shops have been placed in operation.

Daily report of labor and material expenses is made to the master mechanic

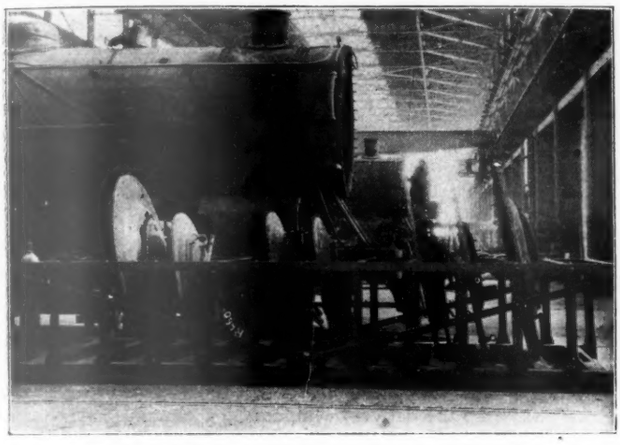
Frequent inspection trips are made through the shop each day by the master mechanic. These inspections enable him to make a note of any unsatisfactory condition and to take proper steps towards its elimination. These inspections are supplemented by a system of labor and material expense control. As soon as a locomotive is brought into the erecting shop for repairs, a record is kept of labor and material expenditures for each day. All work performed in the various departments of the machine, boiler, smith and flue shops is charged direct to the locomotive. Data for these costs is collected by each department foreman from the time cards of the men and requisitions that have been filled by the stores department. These expenses are compiled for each day by a clerk in the master mechanic's office who enters the day's total along with the grand total of labor and material expenditures, on each locomotive to-date, on a chart which is laid on the master mechanic's desk each morning. This chart is ruled with columns for each locomotive in the shops. At the extreme left is a column listing the days of the month, each date being assigned to a separate line sufficiently wide to accommodate both the daily and grand total figures. A column at the right of the column showing actual labor and material expenditures shows the allowance made by the stores department for scrap. The actual expense for repairing each locomotive is obtained



Machine tool and equipment layout of the boiler, blacksmith, forge and flue shops

by subtracting the amount shown in the left-hand column from the amount shown in the right-hand column and this figure is entered in a third column.

No account is taken of shop expense or overhead items as the object of this report is to give the master mechanic a basis upon which to estimate the efficiency and progress of shop production. In other words, the principal value of the figures shown in the report is obtained by comparison with previous expenditures for similar class repairs. When necessary, the master mechanic is also able to determine quickly the total cost of each day's operation. General overhead charges are kept on a separate record to which the master mechanic can refer at any time. Although considerable emphasis is laid on keeping production costs down, quality of workmanship is not sacrificed in the least. Careful inspection of all work by the department foremen, supplemented by frequent inspections by the master mechanic and general machine shop foreman insures a high standard of workmanship.



A rack for front end covers designed to be moved by crane

Machine tools are motor driven

Practically all the equipment used in these shops is electrically operated, alternating current being supplied for the machine tools, yard cranes and transfer table. Direct current is used for the cranes in the locomotive shops. The power, which is purchased locally, is alternating current and is stepped down and used where needed. The current is used also to drive two 150-kw. motor-generator sets for the supply of direct current.

The shop is very largely equipped with the latest design of machine tools and shop equipment. A few machine tools of more recent design were moved from the Alabama Great Southern shops. The large machine tools designed to work on heavy parts are located where they can be served by the 15-ton cranes. The smaller machine tools and work benches are placed beneath the gallery floor and jib cranes have been installed at various strategic points to assist in the handling of material.

The rod department is located at the end of the machine shop next to the blacksmith shop. This location makes it comparatively easy to route the rods directly from the smith shop for finishing without back-tracking or interfering with the work of other departments. Rods are completely finished and bushed in this department from whence they are routed directly to the locomotives in the erecting shop. Racks are provided that hold the rods, to which bushings are being fitted, at a convenient height for calipering and trial fitting.

The repair units for driving boxes, shoes and wedges, crank pins and axles are located in close proximity to each other. Each unit is complete in itself and the various machine tools and shop equipment are located so as to facilitate the work of each department. The axle lathes are located where they can be served advantageously by the 15-ton cranes from and to the adjacent wheel department. The driving box and shoe and wedge departments extend beneath the gallery floor. Driving boxes are bored and faced in the same operation on a Sellers vertical boring mill. This job from floor to floor has been performed in 9 min. Eccentric grooves are cut for holding the brass liners to the driving box face. These grooves are cut 2½ in. wide at the top and are then narrowed down to 2 in. at the bottom. By the use of this method it is unnecessary to drill holes in the face.

Castings and heavy materials are stored in a yard provided with overhead crane service—Platforms for the storage of material are being built in this yard

Shoes and wedges are gaged end to end on the platen of a planer. A jig that will hold four tools is now being built so that both the inside and outside surfaces can be finished at the same time.

Two large driving wheel lathes are located at the ends

of the wheel storage track. All of the machine tools in the wheel department are grouped around the wheel storage track so that they may be readily served by the 15-ton cranes. As the machine shop is also required to handle the work of the enginehouse, provisions have been made in the wheel department to turn unmounted tires. A jig has been devised for holding the tire to the face plate, as shown in Fig. 1. This device is of heavy construction and is secured by means of bolts, the heads of which are inserted in the grooves of the face plate. The clamp *B* which pivots on the pin *D* is tightened against the tire by means of the wedge *A*. The tire is held securely by the clamp against the shoulder *E*. The average time for turning engine truck wheels is 20 min.

The piston rod, guide and crosshead, throttle rigging and motion work departments are arranged in order of work from the wheel department to the end of the shop. Provision has been made to handle miscellaneous castings

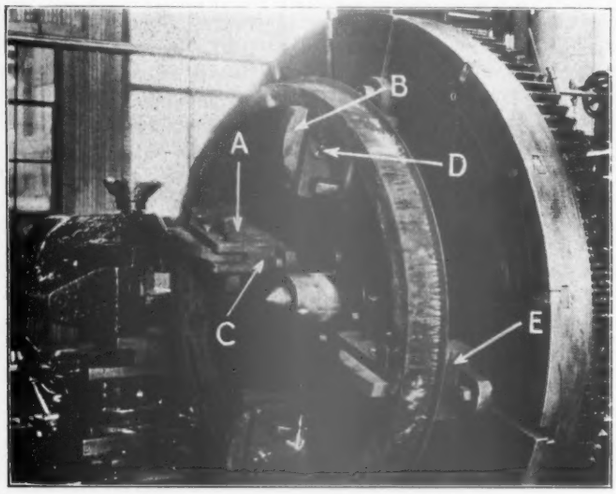
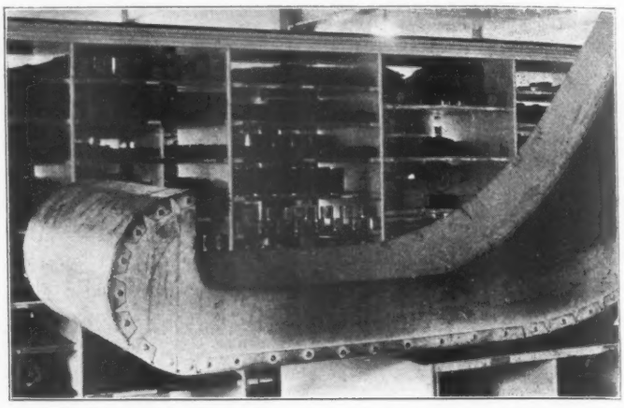


Fig. 1—Jig for holding unmounted tires on the face plate of a wheel lathe

and forgings on a separate group of machine tools. Valve packing rings are finished by chucking them in a 16-in. lathe. Piston rods are ground on an 18-in. by 30-in. by 96-in. Morton cylindrical grinder. A 4-in. Diamond face grinder is used for finishing guide bars, etc. All motion work pins, crosshead pins and knuckle pins are rough turned from the bar and then threaded.

The toolroom is divided into two sections. The repair or manufacturing section is located on the gallery floor while the disbursing toolroom is located directly beneath on the floor of the machine shop. Communication is provided between the two units by a dumbwaiter type of small hand elevator.

Disbursements are made by means of the check system. Tools requiring repairs or grinding are placed in the dumbwaiter by the disbursing unit attendant and hoisted to the manufacturing unit above. Reconditioned tools are



Articles stocked on the second floor of the storehouse are sent to the delivery window by a chute

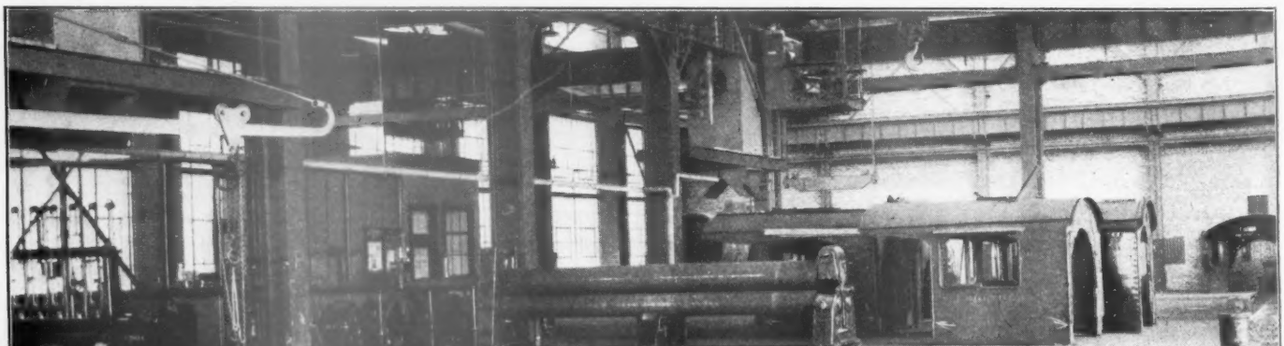
transferred to the disbursing unit below by the same method.

Boiler and flue shop work

The location of the boiler shop with respect to the erecting shop makes it comparatively easy to lift the boiler from the frame and move it to the boiler shop by crane.

Cab repairs are also made in the boiler shop. Boiler sheets are flanged cold on a ¾-in. McCabe pneumatic flanging machine. In this shop, which is well equipped to take care of heavy boiler repairs, is a 48-in. reinforced shearing machine, a Southwark horizontal bending roll, a six-spindle staybolt threading machine, a 16-ft. plate edge planer, a 6-ft. Ridgeway radial drill, and six 2-in. double Acme bolt cutters, all of which are new machines.

The flue shop is located at the opposite end of the horizontal arm of the "T" from the boiler shop. It is well equipped and organized to handle work on a production basis. Flues are handled from the erecting shop to the flue shop by means of a carrier built somewhat in the form of a large basket, which can be picked up by crane. The carrier is placed on a truck and taken by rail directly to the flue shop. Two different gangs are employed, one on tubes and the other on flues, the arrangement of the



Interior view of the boiler shop

machinery being such that all movements are in a straight line as much as possible, thereby eliminating excessive handling. All tubes and flues are tested after being welded.

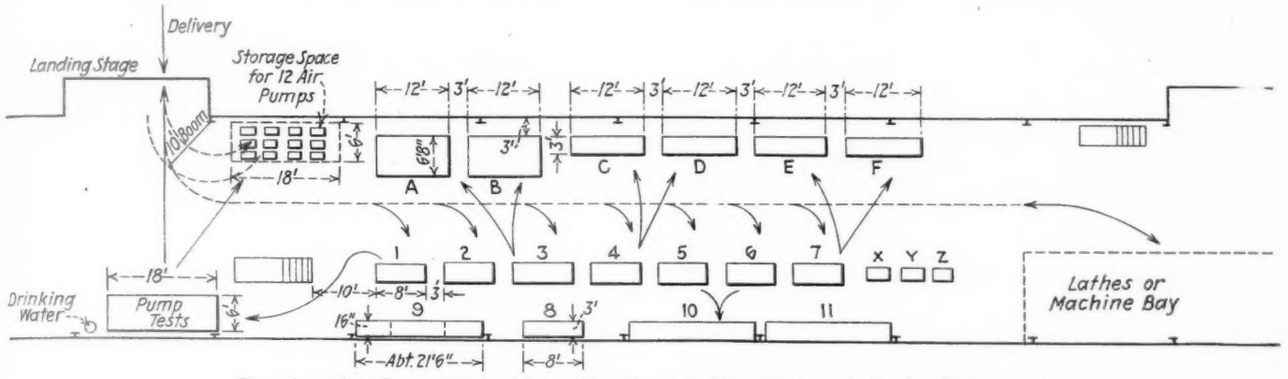
The blacksmith shop

The blacksmith department, located between the boiler and flue shops, is well arranged for efficient performance. Two 1,500-lb. single frame steam hammers are located in the center aisle between two lines of forges. A 3,400-lb. hammer for handling rods and heavy forgings is also provided. An 18-in. double-end punch and shear, and a reverse bulldozer is also included in the new equipment.

The forge shop is located in a bay which is served by a track running through the machine shop. Many locomotive forgings are made in the blacksmith shop of scrap material, such as tender drawbars, binders, equalizers and other parts requiring this kind of material. Radial stay-bolts used in the boiler shop are upset on special machine tools and dies. The new equipment in the forge shop includes a 3½-in. Ajax heavy-duty twin geared forging machine and a 1⅞-in forging machine.

The air brake department

A feature of the shop operation is the organization of the work in the air brake department. This department is located on the gallery floor of the machine shop. Material is delivered by one of the machine shop cranes to a landing stage which projects out into the machine shop bay. The various parts are routed, as indicated by the dotted liens shown in the floor plan of the air brake department. Benches equipped with tools and facilities for repairing air pumps, power reverse gears, injectors and lubricators, cab cocks, feed valves and governors, miscellaneous air brake parts, and valve stems and piston packing are arranged along the outside wall in the order named. Suitable storage bins arranged along the gallery rail have been provided for storing the various parts handled in the department. Scrap brass, steel and cast iron are deposited in separate three-wheeled trucks.



Drawing showing a proposed routing of work through the air brake department

1—Air pump bench.
2—Power reverse bench.
3—Injector and lubricator bench.
4—Cab cocks.
5—Feed valve and governor bench.
6—Miscellaneous air brake bench.
7—Valve stem and piston packing bench.
8—Triple decked storage rack for gages on top deck, safety valve on middle deck, and whistles on lower deck.
9, 10 and 11—U-shape material bin.
A and B—Storage bins for injectors and lubricators.
C and D—Storage bins for cab cocks.
E and F—Storage bins for valve stem and piston packing.
X—3-wheel truck for brass scrap.
Y—3-wheel truck for steel scrap.
Z—3-wheel truck for cast-iron scrap.

Portable benches or wagons for air pumps and feedwater heaters, a number of which are shown in the interior view of the air brake department, have been provided. Holes are punched in the top to suit the different sizes of air pumps and feedwater heaters so that the work can be bolted securely to the wagon. By using this wagon the pump or heater undergoing repairs can be moved from bench to lathe, or vice versa, according to the needs of the mechanic.

The air brake room is located on the gallery floor of the machine shop—Portable benches have been provided for air pumps and feed-water heaters

The stores department

The organization of the stores department is closely in-

List of New Machine Tools Installed in the Finley Locomotive Shops of the Southern Railway, North Birmingham, Ala.

No.	Description	Manufacturer or jobber
1	Chaser grinder	P. H. McArdle Equipment Co.
1	Sundstrand internal radius length and surface grinder	Manning, Maxwell & Moore.
1	Lucas cold saw	Carbon Steel Co.
1	16 ft. Plate edge planer	Consolidated Machine Tool Corporation of America.
1	Tool grinder with Morton clamp center emery wheel	William Sellers & Co.
1	30 in. by 14 in. Quick change gear lathe	Cincinnati Lathe & Tool Co.
1	18 in. by 10 in. Quick change gear lathe	Cincinnati Lathe & Tool Co.
1	Jackson duplex typeless die linker	Walcott Lathe Co.
2	Motor driven wet tool grinder	Safety Emery Wheel Co.
1	3 in. Drill grinder	William Sellers & Co.
1	Springfield Mfg. Co. frame grinder	D. Nast Machine Co.
2	3 in. by 36 in. turret lathes cross feed	Jones & Lawson Machine Co.
1	6 ft. Ridgeway radial drill	Niles-Bement-Pond Co.
1	3,400-lb. Single frame steam hammer	Niles-Bement-Pond Co.
1	Double head axle lathe	Niles-Bement-Pond Co.
1	36 in.-44 in. Side head boring mill	Niles-Bement-Pond Co.
2	1,500-lb. single frame steam hammer	Niles-Bement-Pond Co.
1	44 in. Vertical boring and turning mill	Niles-Bement-Pond Co.
1	53 in. Boring and turning mill	Niles-Bement-Pond Co.
1	Universal collar hexagon turret lathe	Warner & Swasey Co.
6	2 in. Double Acme bolt cutter	Niles-Bement-Pond Co.
1	4½ in. Four-spindle Acme nut tapper	Niles-Bement-Pond Co.
1	48 in. Putnam car wheel borer	Manning, Maxwell & Moore.
2	18 in. Dresses universal monitor lathe	Manning, Maxwell & Moore.
1	20 in. Mechanics back geared compress drill press	C. A. Thumb.
1	28 in. Mechanics Rockford back geared compress drill press	C. A. Thumb.
1	18 in. by 10 in. Heavy engine lathe	Cisco Machine Tool Co.
1	48 in. Reinforced shearing machine	Cleveland Punch & Shear.
1	18 ft. by 8 ft. Bayer & Emmes heavy duty lathe	Manning, Maxwell & Moore.
1	90 in. Driving wheel lathe	Niles-Bement-Pond Co.
1	16 in. by 36 in. Pratt-Whitney Model B tool room lathe	Niles-Bement-Pond Co.
1	12 in. by 30 in. Pratt-Whitney Model B tool room lathe	Niles-Bement-Pond Co.
1	18 in. by 30 in. by 96 in. Grinding machine	Norton Company.
1	18 in. by 8 ft. Heavy duty geared head engine lathe	American Machine Co.
1	Car wheel lathe	Niles-Bement-Pond Co.
1	Reverse bulldozer	Williams, White & Co.
1	84 in. Diamond heavy bar grinder	Manning, Maxwell & Moore.
1	Victor nut facing machine	Manning, Maxwell & Moore.
1	18 in. Double end punch and sheer	New Doty Manufacturing Co.
1	42 in. by 14 ft. Reversing drive planer	Niles-Bement-Pond Co.
1	30 in. Vishold vertical boring and turning mill	Wind Machine Co.
2	24 in. Bement slotter	Niles-Bement-Pond Co.
1	500-lb. Bradley upright helve hammer	Niles-Bement-Pond Co.
2	500-lb. Bradley upright helve hammer	Niles-Bement-Pond Co.
2	36 in. by 16 ft. LeBlond engine lathe	Niles-Bement-Pond Co.
2	15 in. by 6 ft. LeBlond engine lathe	Niles-Bement-Pond Co.
1	17 in. by 6 ft. LeBlond engine lathe	Niles-Bement-Pond Co.
1	600-ton Hydrostatic wheel press	Southwark Foundry & Machine Co.
1	Oster threading machine	Kemp Machine Co.
1	14 in. Allen high speed sensitive drill	Manning, Maxwell & Moore.
20	Blacksmith forge, complete	Ross-Nehan Foundries.
1	24 in. by 14 ft. Lathe	Reed-Prentice Co.
1	¾ in. Pneumatic flanging machine	McCabe Mfg. Co.
1	26 inch Libby turret lathe	Niles-Bement-Pond Co.
1	Cincinnati milling machine	Kemp Machine Co.
1	Southwark horizontal bending roll	Southwark Foundry & Machine Co.
1	Cincinnati Universal milling machine	Kemp Machine Co.
2	6 ft. Plain radial drill	Niles-Bement-Pond Co.
2	Dresses 20 in. universal monitor lathe	Manning, Maxwell & Moore.
1	Niles 100-ton bushing press	Niles-Bement-Pond Co.
1	32 in. Crank shaper	Kemp Machine Co.
1	24 in. by 12 ft. Geared head heavy duty engine lathe	Cisco Machine Tool Co.
1	3½ in. Heavy duty twin geared forging machine	Ajax Manufacturing Co.
1	54 in. Boring and facing machine	William Sellers & Co.
1	Draw cut railroad shaper, with rod brass attachment	Morton Manufacturing Co.
1	36 in. Draw cut pillar type shaper, with wedge box attachments	Morton Manufacturing Co.
1	32 in. Draw cut pillar type shaper turret lathe	Morton Manufacturing Co.
1	90 in. Locomotive axle and journal turning lathe	Niles-Bement-Pond Co.
1	Horizontal milling machine	Newton Machine Tool Works.
1	Niles 36 in. to 44 in. Side head boring mill	Niles-Bement-Pond Co.
1	Flue cleaner	Jos. T. Ryerson & Son.
1	Six-spindle staybolt threading machine	Harrington Company.
1	Grinder, ½ hp. floor type motor	Vandyle, Churchill Co.
1	36 in. by 36 in. by 10 ft. Planer	Niles-Bement-Pond Co.
1	Single vertical adjustable milling machine	Ingersoll Milling Machine Co.
1	36 in. by 36 in. by 14 ft. Pond planer	Niles-Bement-Pond Co.
1	42 in. by 30 in. by 16 ft. Horizontal milling machine	Ingersoll Milling Machine Co.

terlocked with that of the mechanical department in the management of the Finley shops. In order to prevent overstocking and ordering of material that is not being used, a careful check is made of all material on hand by the stores department. Daily reports are made to the stores department by the mechanical department as to what material will be needed in the future and the approximate date.

It is planned to install a delivery system, operated by attendants who will wear red caps, on a 15-min. schedule. The object of the red caps is to easily distinguish the men charged with the responsibility of delivering and collecting material, from the other workmen. Many instances occur when it is desired to expedite a requisition and considerable time can be saved by not having to hunt for a delivery man. Stations will be established in each department provided with a hook for requisitions and bins for the collection of scrap.

Fuel oil is stored in a large tank located near the oil house. Deliveries are made by pipe lines to various stations in the shop. An inventory is taken every 30 days and the amount used is charged to the mechanical department.

At present time requisitions for material from the storeroom are filled at a delivery window opening onto the platform on the side of the stores building next to the boiler

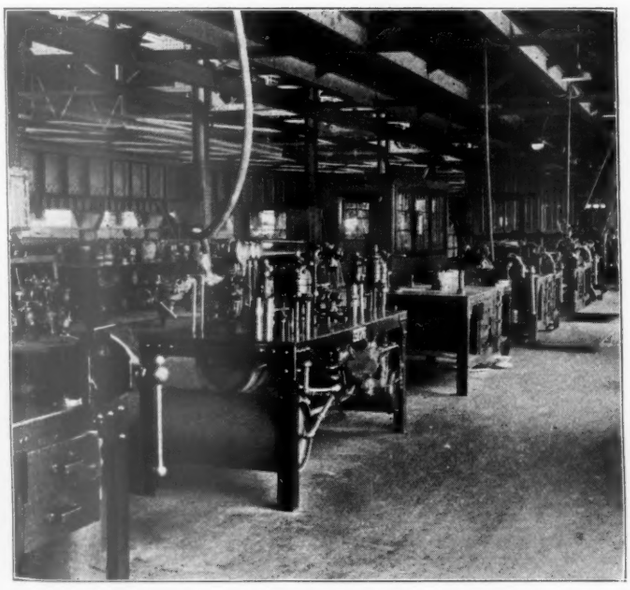
The store room is equipped with open shelves—The unit piling system is employed

shop. The interior arrangement of shelves, racks and bins is well planned and the unit system of piling is used for practically all material. Articles on requisitions for material stored on the second floor are delivered to the attendant at the delivery window by means of a chute. An elevator, with a direct entrance from the outside platform, is also provided for the conveyance of trucks and heavy material to and from the second floor. A cage for storing tools and other valuable material is located on the second floor. Only one key to the door of this cage is issued at a time and it is given to one man who is held responsible for all material contained therein.

Results accomplished since starting operation

Mention should be made of the exceptional results that have been accomplished in the Finley shops as compared to the old system of handling repairs in the shops of the Alabama Great Southern. As previously mentioned the first locomotive undergoing class three repairs at Finley was turned out of the shops in 13 eight-hour working days at a total reduction in cost of labor and material of approximately 40 per cent over the cost to do the same work in the old shops. At the present time class three repairs average 18 days, a reduction in time over the old record of from 45 per cent to 50 per cent and a reduction of labor and material expense of 43 per cent. The cost of applying a new firebox, including general repairs to machinery, has been reduced by 33½ per cent to 40 per cent. Similar reductions have also been accomplished in practically all classes of repairs.

No small share of the credit can be given to the excellent spirit of co-operation and interest that has been shown by the men and the supervisory forces. This spirit is due largely to the efforts of C. E. Keever, master mechanic, Finley shops, and H. W. Miller, vice-president, who personally placed the shops in operation on October 1, 1924, at which time there were 12 locomotives awaiting repairs. The new shops were planned under Mr. Miller's general direction, the machine tool and mechanical department details being worked out under the direction of R. L. Ettenger, mechanical assistant to the vice-president.



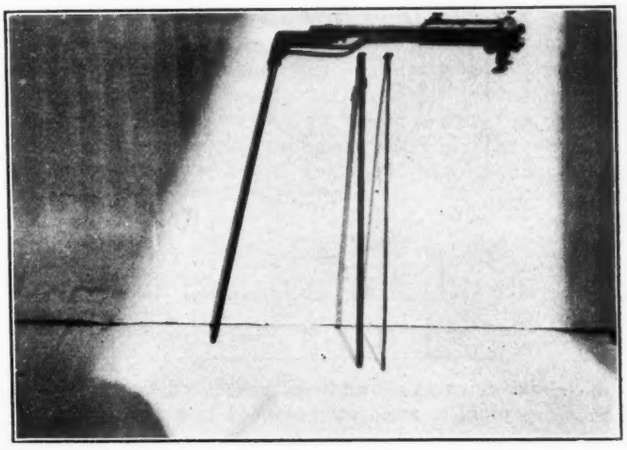
Interior view of the air brake department—Triple valve test rack in the foreground

Saving time with an acetylene cutting torch

By David Pearson

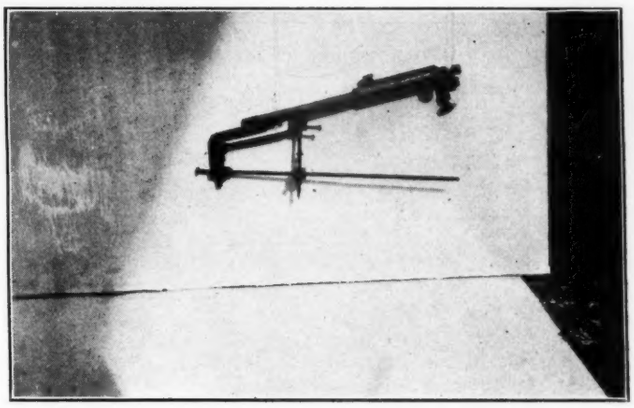
Welder foreman, Atchison, Topeka & Santa Fe, San Bernardino, Cal.

CUTTING circles with a hand acetylene cutting torch is a tedious, crude operation at the best. The operator experiences great difficulty in keeping his hand steady enough to produce an even cut. Fig. 1 shows a simple arrangement whereby these objectionable features are greatly reduced thus effecting a considerable saving in time and labor. The device consists of a radius bar one end of which is fixed to the torch tip. There slides along this bar a pivot bar one end of which fits over and slides along the acetylene pipe of the torch. Suitable adjustments are provided to take care of the various radii.



Extended cutting tip for getting into inaccessible places

The acetylene operator is often confronted with the problem of trying to reach inaccessible places with the cutting torch. Fig. 2 shows an extension tip for reaching such places. It is made from a piece of copper tubing and a rod. One end of the tubing is threaded and fitted with a nipple which is screwed in where the cutting tip normally goes. The rod fits inside of the tubing. These extensions have been used to lengths of 10 and 20 ft. The device can be readily used in connection with boiler repair work.



Attachment for cutting circles with an acetylene torch

Tool for machining ball rings on a lathe

BALL rings shaped like the one shown in Fig. 1 are sometimes used in connection with piston rod packing, valve stem packing, and at other places on steam locomotives. The shape of the rings presents no particular difficulty in machining operations when they are made in such quantities as to justify tooling up a ma-

Fig. 1—Ball rings, as shown here, present a difficult machining problem when not produced in quantity

chine suitable for the job. But when they are finished on an engine lathe and shaped to a template, the results are not always satisfactory. Changing the parting tool and forming tool requires careful adjustment each time a change is made. This method involves repeated trial cuts and settings, with attendant loss of time.

The tool shown in Fig. 2 is made by chucking or clamp-

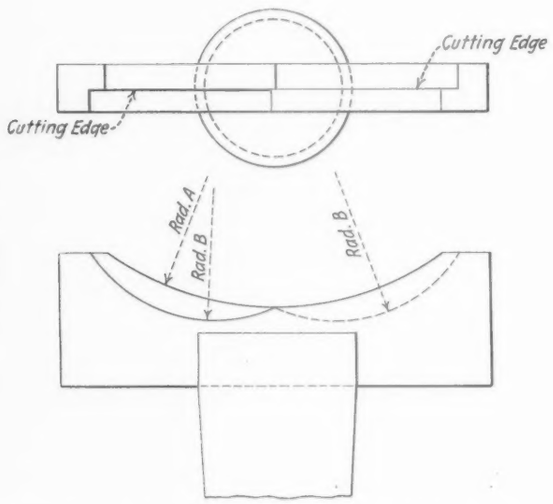


Fig. 2—The tool is placed on the live spindle of the lathe and adjustments can be made by moving the tail stock

ing to the face plate of a lathe a piece of tool steel of suitable section and by boring the radius *A*. Care must be taken in setting the piece to place it in such position as to have the radius extend beyond the diameter of the rings to be machined. After the radius *A* is completed the work is reset and the radius *B* is machined, as shown in Fig. 2, half through the thickness of the piece, reversing the operation on the opposite end. This brings the cutting edges of the opposite ends along the center line, insuring the contour of the finished work to be of suitable radius.

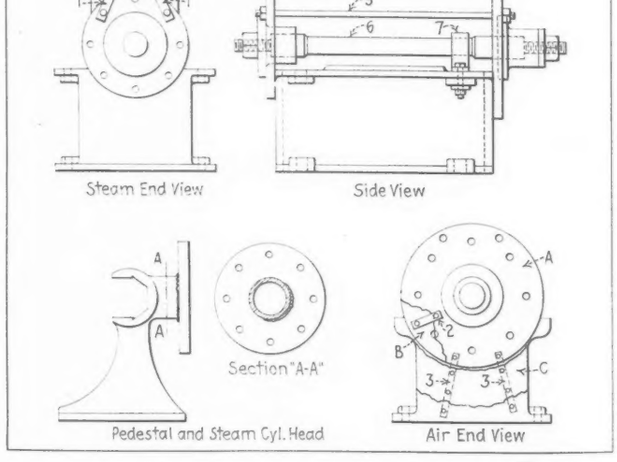
The shank is slotted endwise to receive the cutter. If it is desired to use different cutters in the same shank they may be positioned by the use of a centering dowel. The shank is turned to fit the tail stock spindle.

In using a forming tool of this kind, any variation in the alignment of the tail stock spindle with the live spindle will interfere with an equal distribution of the cut on the opposite ends of the tool. In placing the tool on the spindle it is well to set the cutter at an angle of about 45 deg. from the horizontal. In this way a slight side movement of the tail stock will furnish sufficient adjustment to center the tool and to overcome interference due to unequal spindle heights.

Oxy-acetylene welding of cast iron with brass

By V. T. Kropidlowski

A SMALL, Ingersoll Sargent 10-in. by 10-in. by 10-in. straight line air compressor was broken almost beyond repairs, presumably due to a piston rod nut becoming loose and falling down in the clearance space. A number of parts were broken away entirely. The air cylinder head integral with the main frame was broken from the frame in two pieces as shown in the



Method of holding broken pieces together when making a brass weld on cast iron

illustration at *A* and *B*. A piece *C* broke out from the end of the frame. Two pieces, *E* and *D*, were broken from the steam cylinder end of the same frame. The other steam cylinder head, integral with the pedestal, was cracked, and the center was knocked out of the other air cylinder head.

As it was imperative that the compressor should be repaired as quickly as possible, the broken parts were set up in their relative positions and held in place by bolting them with strips of iron such as designated by 1, 2 and 3 in the drawing. A mandrel, 6, was turned up in a lathe so that its ends fitted snugly in the stuffing boxes of the two cylinder heads. The ends of the mandrel were

threaded to take 1¼ in. nuts which held the heads rigidly in place against expansion and contraction during the process of welding. A strap, 7, with a prop underneath the mandrel was bolted to the frame near the air end to hold the mandrel parallel with the guides. In addition, rods 4 and 5 were used.

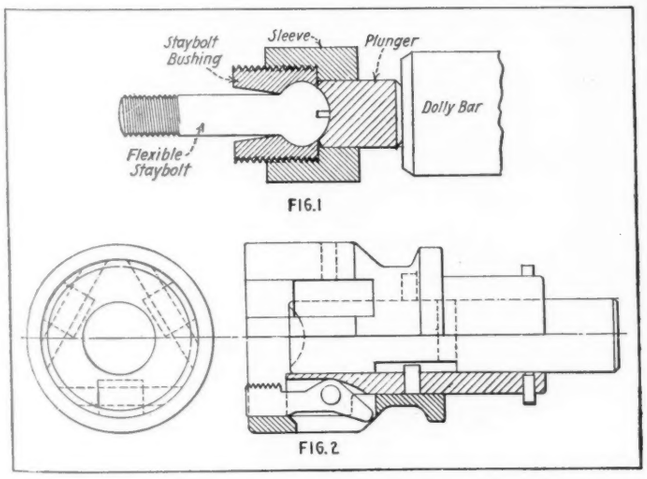
The oxy-acytelene method of welding was used, the welding material being brass. The compressor was of cast iron and if iron filler had been used the work would have had to be heated to redness, causing the casting to crack in the thinner sections at the time of cooling. In using brass as a filler, it was only necessary to heat the work slightly. There is a further factor of safety in using brass because it possesses a quality of flexibility which prevents cracks in the welds by reducing the strains set up by contraction when cooling. The casting was preheated by a gas burner, made from a ¾-in. pipe having ⅛-in. holes drilled in it similar to those in the hoops used in heating driving wheel tires.

When the job was done the casting was practically perfect in alinement. The air cylinder head *A*, was a scant 1/32 in. out vertically, which could have been easily dressed by hand, had it not been that it was readily faced in a 53-in. boring mill. The cylinder head integral with the pedestal was repaired by grooving around the crack and filling in with the acetylene torch using brass as a filler. The front air cylinder head which had the center knocked out was repaired by boring the center and threading it. A brass plug was then made, screwed in and welded in place.

The whole job cost $385 including a general overhauling which was not due to the accident. The job was completed within a month.

An improved dolly bar for holding on flexible staybolts

IT has long been known that the old method of holding on flexible staybolts for driving was slow and inefficient. A number of devices have been developed with a view to eliminating some of the drawbacks. Many of



Old and new devices for backing up flexible staybolts

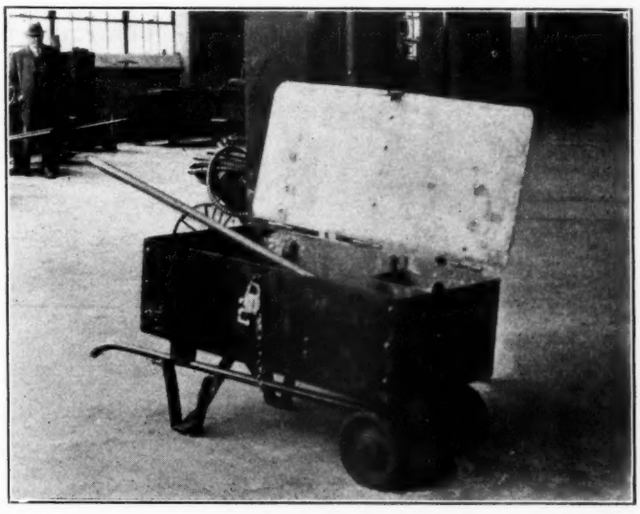
these have been found exceedingly helpful and in the list can be included the one described below which was developed at the Boston & Maine shops, Billerica, Mass. In the old method, as shown in Fig. 1, it is necessary to screw on the bushing sleeve for directing the plunger and for holding it in place. After the driving operation, time is required to remove it and fit it to another bushing. In driving a complete installation of bolts a great deal of valuable time is thus wasted in an operation that might be eliminated.

In the case of the new holder-on, as shown in Fig. 2, the operation can be done instantly. The opening sleeve which slides on the body of the device, when drawn back moves the cams actuating the three threaded gripping dogs and allows the holder-on to be easily slipped into place on the bushing. When the sleeve is moved back to its normal position these dogs grip the bushing threads securely and the operation can go forward. The plunger, which also moves in the body of the tool, is backed up by the dolly bar exactly as in the case of the old type holder-on.

To remove the device from the bushing after the driving operation is completed, it is only necessary to draw back on the control sleeve and the grips are instantly released. The device can of course be made of any practicable size—the one shown in Fig. 2 being designed to fit 1¾-in. flexible staybolt bushings having 12 threads per inch.

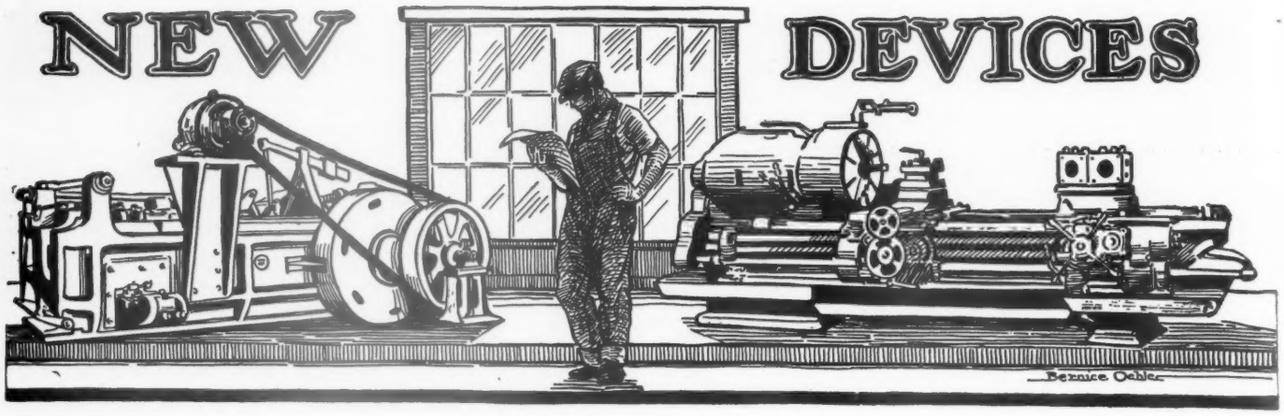
Portable tool box for the engine-house mechanic

PORTABLE tool boxes of the type shown in the illustration are used in the engine houses of the New York Central at its Selkirk terminal near Albany, New York. It is constructed of light sheet metal with a raising lid, which is provided with a hasp. Several small compartments for small tools are placed near the top so that the entire bottom of the box is left clear for the larger and heavier tools. The truck frame is constructed of two



A tool box which insures the enginehouse mechanic that his tools will be available when needed

lengths of extra heavy 1-in. pipe, which are extended so as to form the handles, and 1¼-in. by ¼-in. rolled steel bar. It has proved to be very convenient in enginehouse work. Each mechanic has his own tool box which is identified by a number stenciled on the side. Individual padlocks may be used to lock the box when it is not in use and the mechanic is always assured of having a full complement of tools when needed.



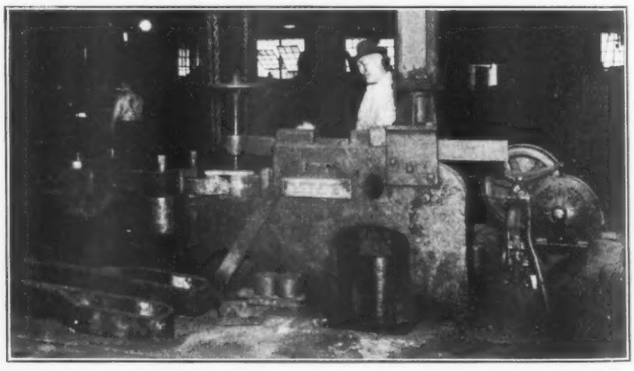
Adjusting machine for the blacksmith shop

LENGTHENING, shortening and straightening by hand the various parts of the running and valve motion gear of a locomotive has always been considered a slow and inaccurate method of doing this work. The Walter Stock Adjusting Machine Company, Toledo, Ohio, have placed on the market an adjusting machine which has apparently solved this problem. It is made in four types all of which are identical in design, the only difference being the kind of power used for operating them. The type recommended for most railway shops is the one equipped with an electric motor driven hydraulic pump. This type is not dependent on any other equipment except electric power which is generally available and seldom out of service for any length of time. It is also always ready to operate without first starting up some other power unit such as the pumps on a hydraulic accumulator.

The construction of the machine is very simple, consisting of a frame, two toggle links, a ram, a filler, wedge and sliding block, four eccentric gripping cams, a clamping bar complete and two binding links. The two toggle links and the ram are joined together. The end of the rear link rests in a recess provided in the frame and is held in position with a pin. When the machine is in operation no pressure is exerted on any of the pins joining the links and the ram. Provision is made in the frame for the reception of the filler block, the sliding block, the two eccentric gripping cams and the wedge block.

Shortening an axle in the Walter Stock adjusting machine

When using the machine for shortening operations, the work can be held by either the forward or rear cams. If the rear cams are used, the sliding block is prevented from moving by placing the wedge block in one of the recesses of the frame provided for this purpose. When the pressure is first applied there may be some little slipping of the piece before the cams will grip it. Should the ram reach the end of its stroke before the operation is completed, the pressure should be released, and the space filled up with pieces of suitable dimensions, and the process repeated until the necessary adjustment is made. One end of the work is held by the cams, the other end is in contact with the ram, and the heated portion is between the two. As the pressure is applied the ram, pushing against the end of the work, upsets the part in the heated area.

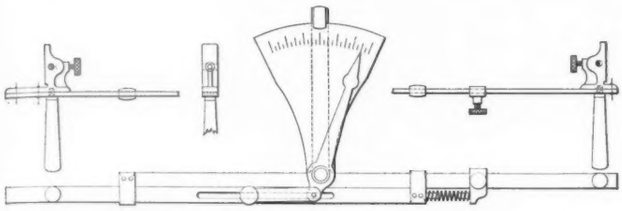


Motor driven adjusting machine closing up the jaws of a pedestal binder

When a piece is being lengthened it is held by two pairs of cams, with the heated portion between. The wedge block is removed and the space between the ram and the filler block as well as the space between the filler block and the sliding block is made up with false pieces. Pieces of scrap channel, side-rods or main rods cut in various lengths make the best filling-in pieces as they are light and more easily handled. Care should be taken to see that there is space allowed for the ram to extend to the limit of its stroke without touching the end of the part to be lengthened. It can be readily seen that with all space between the ram and the sliding block filled up, making a direct connection between these parts, any extension of the ram will move the sliding block. The part to be lengthened has one end held by the cams in the

frame, and the other end held by the cams in the sliding block with the heated portion between. As the sliding block is pushed, the piece will be stretched and lengthened.

For ordinary straightening jobs, it is necessary to place the wedge block behind the sliding block, to prevent it from moving. The work is placed cross-wise in the machine and the space between is made up so that the filler block will reach the work. As the ram moves forward the work is pressed against the sliding block and straightened. For straightening main and side rods it is advisable to have two heavy bars of steel about 4½ in. by 8½ in. by 40 in. machined all over, which are placed cross-wise in the machine. A badly bent and twisted main or side rod can be heated in a furnace and placed between these bars and made perfectly straight without a twist. There will be no hammer or die marks, and no thin spots.



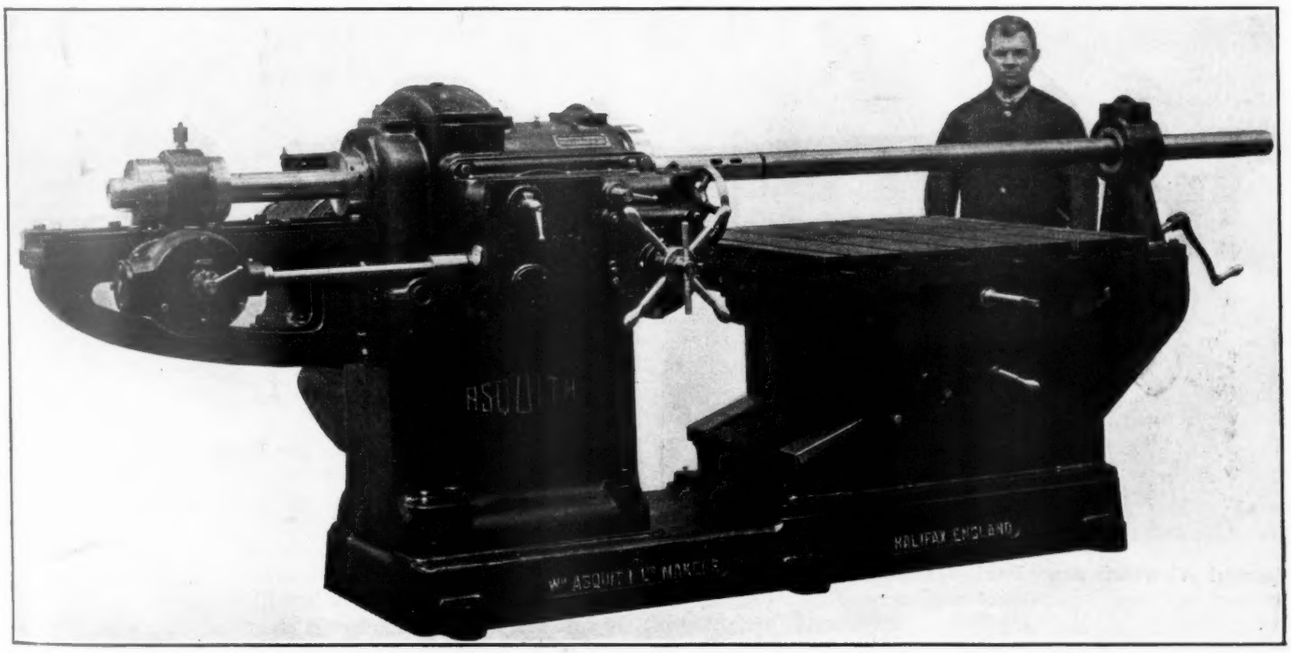
A gage with the machine which provides a means of making accurate adjustments when used on pedestal binders, side rods, drawbars, etc.

The gage with which each machine is furnished is an important feature of its equipment as it provides a means of making very accurate adjustments. When using the gage on pedestal binders, side rods, draw bars, etc., it is not necessary for the blacksmith to make the customary "hot and cold" marks. The lugs on each end of the gage are designed to slip into the jaws of the binder and a spring insures constant pressure against the binder jaws. As the machine pushes the jaws of the binder together it causes a hand to move across the dial, which is graduated at a six to one ratio which means that the graduations on the dial, which are 3/32 in., show that the work has been shortened 1/64 in.

Horizontal boring machine for journal box bearings

A SPECIALLY designed machine for the economical boring of journal box bearings has recently been developed by Wm. Asquith, Ltd., Halifax, Eng. The boxes are mounted on a strong work table which is provided with suitable T-slots. It is adjustable by hand motion on an angular slide, in order to enable the machine to handle boxes of varying heights. The boring bar, which carries the cutters, is cottered into the No. 5 Morse taper end of the spindle, and is removed through the steady rest after the cutters have been removed.

The spindle is of high carbon steel, accurately ground between dead centers, to be truly cylindrical. It is subject to no rotary wear, but simply slides in a large, accurately ground sleeve or socket. The spindle has a variable self-acting feed motion, fine hand feed motion, and a quick adjustment by hand, through rack and pinion. The sleeve which carries the spindle is of ample diameter for its purpose and has conical bearings at the front and rear. These bearings are accurately ground and are adjustable for wear, so as to maintain the correct alinement of the spindle with the steady rest bearing. The spindle feeds are obtained by means of a change feed



Asquith boring machine provided with a table adjustable on an angular slide by hand motion

gear box, the control to which is conveniently arranged.

The steady rest for the boring bar is firmly secured to the end of the angular table slide. The boring bars also are not subject to rotary wear, as they slide through a steady bushing and rotate in a large conical bushing in order to allow for taking up wear.

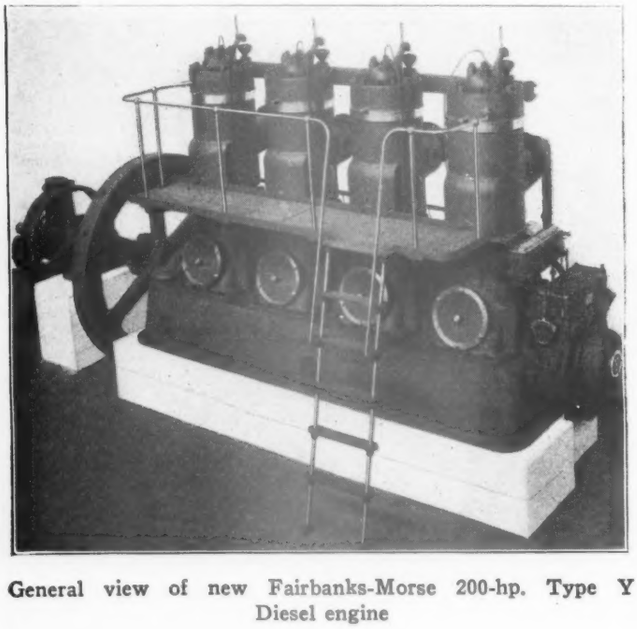
The machine is arranged for self-contained motor drive, the 5-hp. motor being mounted on a suitable bracket at the rear of the machine. Where d.c. current is available, the motor recommended is of the variable speed type with a speed of approximately 400 to 1,200 r.p.m.; where a.c. current only is available, the motor can be of the constant speed type, driving through a three speed gear box.

The complete machine is mounted on a strong foundation plate which is well ribbed to obviate deflection. The arrangement of the machine illustrated is such, that two boxes may be handled at one setting, being arranged in line with each other. It is possible, however, to handle four boxes at one setting by the adoption of the duplex form of the same type of machine. This duplex form is generally similar to the machine above described, except for the twin spindles, the two steady rests and the relatively larger dimensions. In this case the arrangement is such that each spindle deals with two boxes in line.

Changes in Fairbanks-Morse Diesel engine

ONE of the reasons for the increasing interest in the application of Diesel engines to a wide variety of railway power problems, such as the furnishing of power, light and pumping service, is in the increased dependability of these prime movers due to the constant mechanical improvement of the designs. Normal progress has indicated that an engine which would start without the aid of auxiliary ignition devices was an advantage and an improved design incorporating this feature has been brought out by Fairbanks, Morse & Co., Chicago.

No changes have been made in the general type of engine as the two cycle principle has been adhered to and the combustion scheme is based on solid injection of fuel as in the former Type "Y" engine. The engine operates under a compression of 500 lb. and the increased heat due to this compression fires the fuel without the aid of a torch when starting.

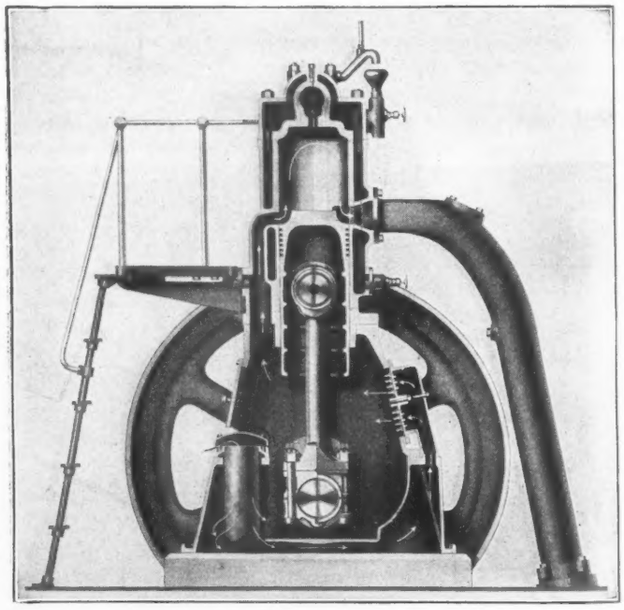


General view of new Fairbanks-Morse 200-hp. Type Y Diesel engine

Piping has been eliminated or enclosed, the control simplified, and what few adjustments there are, have been made more accessible without sacrificing simplicity of construction and reliability of operation.

At the present time the engine is built in ratings of 37½ and 50 hp. for the single cylinder unit; 75 and 100 hp. in two cylinders; 150 hp. in three cylinders; 200 hp. in four cylinders; and 300 hp. in six cylinders.

The primary consideration has been to develop an engine of the greatest reliability with low maintenance costs, maximum accessibility and one which is simple to operate. Fuel economy was also carefully considered, although no sacrifices were made in ultimate performance to secure the lowest possible test consumption of fuel.



Transverse section through the engine—The path of scavenging air indicated

The tests which have been conducted show a fuel consumption of 0.42 lb. of 18,000 B.t.u. fuel oil per brake horsepower-hour at full rated load. One of the characteristics of the engine is that the fuel consumption curve is practically a straight line on ratings varying from 75 to 120 per cent load.

From the sectional view it will be noted that the fuel is sprayed into a combustion chamber. This part of the design is quite similar to the former design except that certain improvements have been made in the shape of the chamber and in the neck leading to the cylinder. One advantage of this combustion chamber is that the air, on the compression stroke, rushes through the neck of the chamber and meets the atomized spray from the injection nozzle. The turbulence caused by this meeting of the air and fuel aids in preparing the fuel for complete combustion and also holds the charge in suspension. Owing to this thorough preparation of the fuel the final

burning is accomplished without an initial rise in pressure, resulting in true Diesel indicator cards. This system also eliminates the need for high injection pressure or a complicated injection nozzle of a type where the oil is sprayed through extremely fine holes.

When the piston reaches the end of its stroke, the temperature of the fuel charge in the auxiliary combustion chamber is raised to the ignition point and combustion begins. The hot gases then expand through the neck of the chamber and combustion is completed in the cylinder. In this way complete combustion is obtained as shown by the clear exhaust, from light load to over-load conditions. Moreover, the combustion does not cause any rise in pressure above the compression pressure, and the expansion is, therefore, similar to that of steam.

The fuel injection system is of the same general design as used in the former engine with the exception that the pumps are grouped on a pump deck and enclosed in a case which serves as the fuel oil reservoir. The change in the design has provided a more compact arrangement since it eliminates suction piping. By having the fuel pumps submerged the possibility of their becoming air bound is prevented. This fuel injection system, governor and the complete control of the engine centers in a unit mounted at the right end of the engine as shown in the general view.

Starting is accomplished by means of compressed air, the air being stored by an auxiliary power compressor in steel tanks of sufficient capacity for several starts. The pressure used for starting is approximately 200 lb.

Another important point in Diesel engine design is in the arrangements which are provided to eject the burned gases at the end of the expansion stroke. One of the improvements which has been made in the new design is that this scavenging air is transferred from the crank case to the cylinder through a passage outside the water jacket, thereby eliminating the necessity for air ports in the pistons and allowing the cylinder to be completely water-jacketed for its entire length. Reference to the sectional view will give an idea of how the scavenging air circulates through the base and to the cylinder. Before the opening of the air inlet or scavenging ports, which occurs shortly after the opening of the exhaust ports, the exhaust pressure drops to virtually atmospheric pressure. The air which has been compressed to a low pressure in the crank case, enters the cylinder when the scavenging ports are uncovered and is deflected by the piston to the upper portion of the cylinder, clearing out the remaining burned gases and charging the cylinder with fresh air. This scavenging air is supplied by the piston and crank case acting as a pump. On the upstroke of the piston, air is drawn through a screen and automatic air valve, into the crank case and is compressed on the working or downstroke.

Cooling water is introduced into the jacket of the head at both a top and bottom connection with the result that the whole jacket has a practically uniform temperature. The ridges of the cylinder ports are also cored for water passages and are thus kept at a uniform temperature. At the cooling water outlet, at the top of the cylinder head a spout is provided that discharges into a water header. This arrangement gives a visual check on the water circulation. Where the cooling water supply is limited and a re-circulation system is necessary, a closed connection from the cylinder head is used. In either case thermometers are provided for checking the cooling water temperature.

In the new design, several changes have been made in the lubricating system. The new system is entirely automatic, consisting of a double lubricating oil pump and an outside filter. The lubricating pump supplies oil to the mechanical lubricator, governor case, and main bearing wells. The governor case and main bearing wells are inter-connected and the oil is maintained at a constant level in them by the lubricating pump.

Used oil drains from the crank case to the oil sump and is pumped from this sump to the filter. The filter is entirely separate from the engine and is an efficient two-compartment type of large size, permitting the slow settling and filtering of the oil. Clean oil only is pumped from this filter back into the engine. One of the rather unique features of the lubricating system is the entire absence of oil caps, grease caps or oil holes. An oil can is unnecessary.

A welding flux suitable for iron, steel and bronze

WELDING flux plays an important part in making a homogeneous weld free from impurities. The chemists and metallurgists of the Chemical Treatment Company, New York, had these requirements in mind when they selected the ingredients of the welding flux known under the trade name of Welfex. The raw materials are passed through several progressive stages of manufacture for the purpose of securing a thoroughly uniform product.

The manufacturers claim for it several properties desirable for an effective welding flux. Its use gives a strong, soft and ductile weld or patch which can be machined, faced or drilled without chatter or change of speed and it can be readily used with all high temperature welding methods. The slag produced not only protects but absorbs the impurities from the exposed surface of the hot metal. It also prevents serious changes of silicon or carbon content in the metal. Welfex is a desulphurizer, the affinity of its slag being greater than that of the fused or molten metal.

When using the flux, one end of the welding rod is heated with the torch flame and when brought to a cherry red is dipped in the flux which will fuse and form a coating over the rod. The heat of the torch will then cause the flux to flow from the rod to the weld. The end of the rod and the welding area should be kept well covered with this coating of slag.

If the welding is to be done on heavy or massive work, additional flux should be provided by direct supply to the surface of the weld. Care should be exercised in having the flux form a fluid slag, of sufficient quantity to float over and completely cover the metal under fusion. This is essential, as the important service rendered by a fluxing slag is to dissolve metallic oxides, and shield the molten metal from oxidization.

The higher the temperature of the molten metal, the greater its affinity for oxygen. The quantity of flux to be added is regulated by the welding conditions. It should be used liberally rather than sparingly. This question must depend upon the judgment of the welder. If the flow of the welding metal is sluggish, additional flux will increase fluidity. Care should be used, however, to avoid excessive fluidity which would create a greater tendency for too rapid chilling of the welded metal.

Disk bearings for railway cars

THE Wollmar Engineering Corporation, New York is introducing a disk bearing for use on railway cars which is said to have all the advantages of ball and roller bearings with additional carrying capacity. The construction of these bearings, which are known as NKA disk bearings, is shown in Fig. 1. It will be noted in the drawing *Y* that the rolling surface of the disks has symmetrical with the points *D* and *E*. If, for example, the disk should tend to turn to the right in the plane of the paper and the bearing continues to rotate, the ellipsoid will appear as shown on the dotted line with the points of contact moved to *F* and *G*. These points not being opposite to each other will produce a moment which will turn the disk to the left in the plane of the paper and back to its

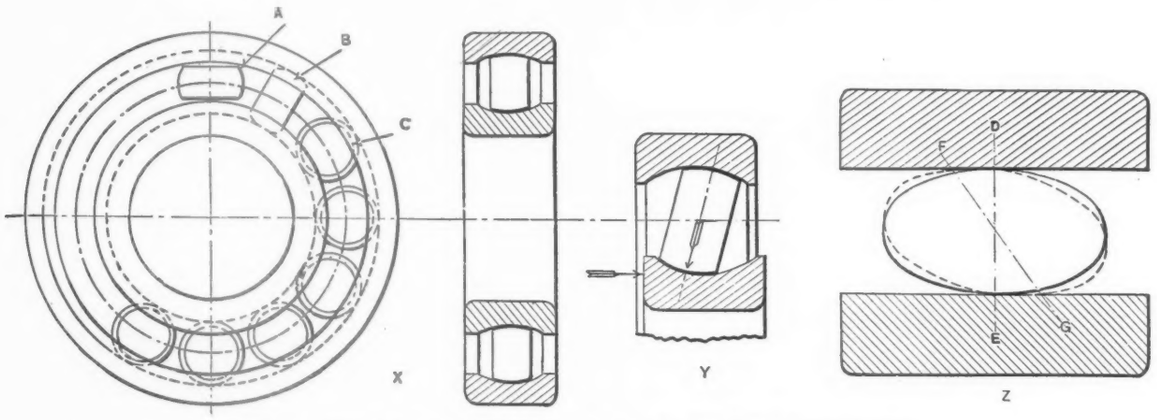


Fig. 1—Drawing showing the construction of the NKA disk bearing

a radius of curvature larger than the diameter. The disks run in race grooves which are so dimensioned that practically the entire width of the roller comes in contact with the groove when the bearing is under load. This gives nearly a line contact between the rollers and groove

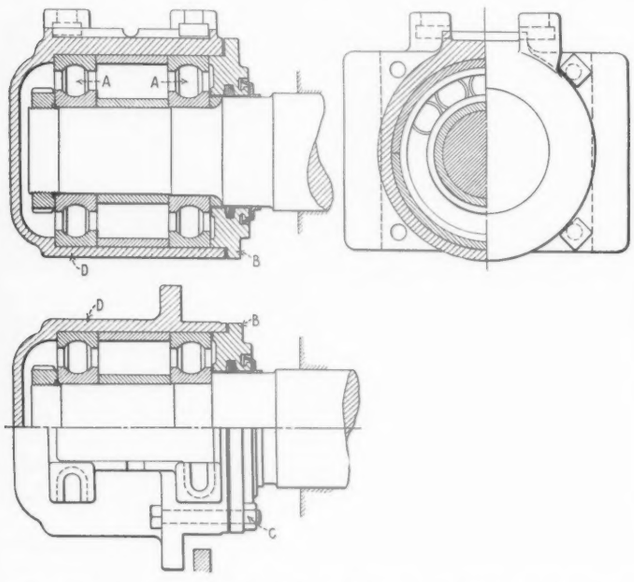
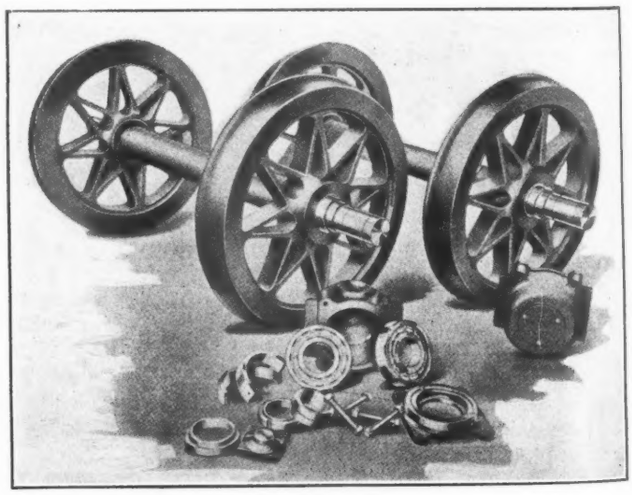


Fig. 2—Drawing showing the application of disk bearings to a railway car journal

which permits them to be self-guiding and allows a larger load carrying capacity.

The self-guiding feature may be explained by referring to the drawing *Z* in Fig. 1. If we consider each disk to be cut from an ellipsoid of rotation and placed between two flat surfaces as shown at *Z*, the ellipsoid will roll on the smallest great circle and the contact surfaces will be normal position. This action of the ellipsoid has been termed statical self-guiding. This statical self-guiding, however, is not sufficient to produce even running of the disks, because if the bearing is subject to radial pressure one-half of the disks will be without pressure and statical self-guiding cannot exist.

The moment of inertia about the normal axis of rota-

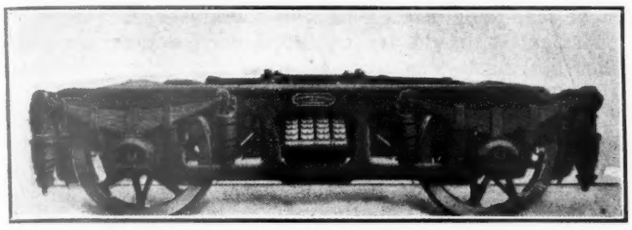


Disk bearings disassembled from a European type railway car

tion is greater than the moment of inertia about any other axis due to the slight width. As a result, the disks are also termed to be dynamically self-guiding. It is well known that a free rotating body always tries to rotate about the axis which has the greatest moment of inertia.

If the disk bearing is subjected to an axial pressure only, the resultant force on each disk makes an angle with the axis of rotation of the bearing, and the disks take a

position as shown in drawing *Y* of Fig. 1 to react against the axial stresses. If a bearing is subjected to both axial and radial stresses, the various disks have different angles



European railway truck showing the application of disk bearings

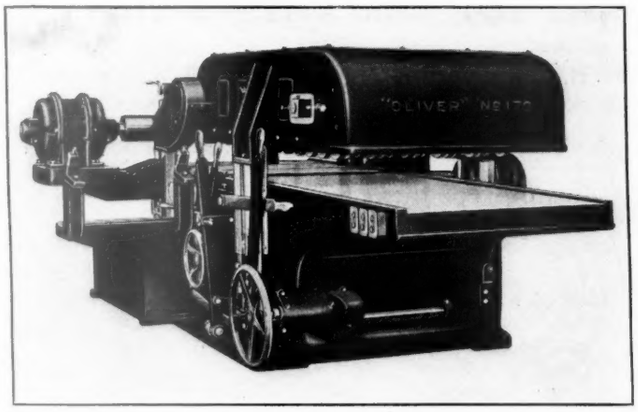
of reaction, the degree of which is decided by the resultant force which is exerted on them. The self-guiding properties of these disks have been verified by practical trials with bearings run without a cage. Their shape permits them to be inserted between the races shown at *A* in the drawing *X* of Fig. 1, twisted into position as shown at *B* and finally to the position *C*.

The NKA disk bearings have been used successfully on railway equipment of the Swedish State railways. The application of these disks to European railway equipment is shown in Fig. 2. Each journal has two bearings which are located at the ends of the journal. This design permits a distribution of the loading over a larger surface and it is also claimed that it can withstand shocks and temporary overloading to great advantage which is a much desired feature.

The work of development on European railway equipment was conducted by the manufacturers, Nordiska Kullager Aktiebolaget, Gothenburg, Sweden, from which the bearing derives its trade name.

Woodworking machines of unique design

THE Oliver Machinery Company, Grand Rapids, Mich., has recently placed on the market under the trade name of "Straitoplane" a woodworking machine, the purpose of which is to do on one machine in one operation what heretofore has been done on two machines in two operations. The two machines referred



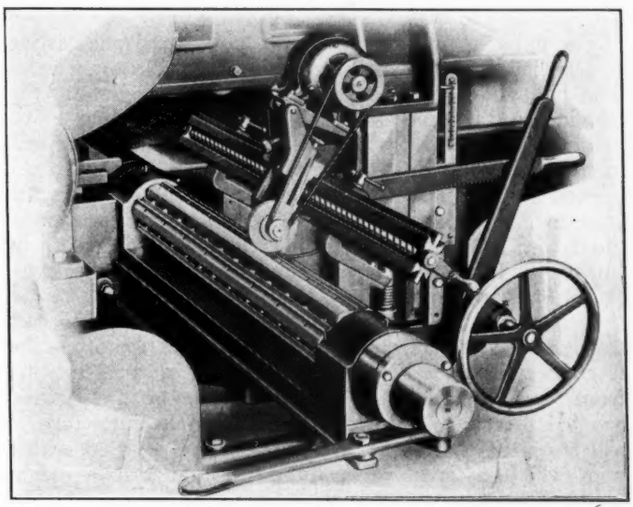
Front view of the Oliver "Straitoplane" showing the concentration of control levers

to are the hand planer and jointer, with some kind of a power feeding attachment and a surfacer. One of the outstanding features of the machine is its ability to take warped boards and finish them down to the desired dimensions, the finished product being smooth and straight.

The infeed table is a one-piece casting of arched ribbed construction. It has an actual feeding surface of 36¼ in. wide by 72 in. long. The end next to the bottom head is fitted with a steel plate. This table is supported by an inclined bed wedge which is a one-piece casting and rides on dovetailed gibbed ways for vertical adjustment by means of a ratchet lever on the left side of the machine, convenient to the operator. The frame of the outfeed table is a one-piece well ribbed casting with finished chilled plates bolted at the top to form an actual feeding surface of 36¼ in. wide by 41 in. long. In finished pockets at the sides of the outfeed table frame, bronze bearing boxes support the two lower feed rolls with adjustment for alinement. The outfeed table frame is supported by an inclined one-piece cast bed wedge in wide finished ways and is easily adjusted vertically to the cutting edge of the knives by means of a hand wheel conveniently located on the left, or operating side, of the machine.

The entire top section of the machine consists of two main castings securely bolted together. It is supported by four rectangular pillars fitted to the main frame in the slot gibbed ways and arranged to move vertically in unison by power, supplemented by a hand wheel micrometer set for the finished thickness desired. This top section carries the multiple contact conveyor, the top feed rolls, and the top cylinder unit with the chip breaker and pressure bar. The vertical movement is indicated by a scale and pointer within direct and convenient view of the operator.

The conveyor is of the wide chain mat type, having



View of the bottom head pulled out and resting on the self-contained bracket with the knife grinding attachment in use

cushion spring cam-dogs suspended from each link in such a manner as to assure a very sensitive, yet positive multiple contact feed. All essential parts of the conveyor are made of malleable steel. All parts are properly lubricated and positive take-up is provided to compensate for any possible elongation of the conveyor.

The main frame is a rigid casting with cored sides, girts, partitions and exhaust chute for the bottom head—

all cast in one piece. This frame supports, completely, all other parts of the machine on finished surfaces. The bottom is planed to give a solid continuous foundation support of 9½ in. wide by 72 in. long on both sides of the machine.

The top roll, ahead of the top cutter head, is sectional and is arranged with ample vertical movement for each section and also for the roll, as a whole, so that any desired top cut can be taken with ease. All other rolls are smooth, arranged for vertical adjustment to give proper alinement. The feed works are actuated through an initial belt, having a double idler take-up, controlled by a lever and ratchet stop, located at the left side of the operating end within easy reach of the operator, giving him easy control to throw the feed on or off, while the machine is running. Roller chains and sprockets are provided.

Both the top and bottom cutter heads are of 6-in. cutting diameter, fitted with six Tungsten thin knives. Provision is made for setting the knives easily and for joining and grinding the knives in the top cutter head when in place. The bottom cutter head is clamped in the frame with a tapered wedge going clear across the frame. This wedge is released by a convenient lever and the entire bottom head, with its bearings and housing yoke, are drawn out towards the left side of the machine, for setting and grinding the knives while resting on the sliding bracket which is fastened to the machine and always remains in place. The knives of the bottom head can be jointed in relation to the outfeed table, by raising the top section to the 6-in. limit and mounting the jointing head on the rear table directly back of the knives.

The cutter heads are equipped with double rows of roller bearings. All other bearings throughout the machine are of the bronze bushed type and all bearings are lubricated by the Alemite system. Complete control of the machine is located at the forward end of the left side so that the operator can, within easy reach of his natural position, stop and start the heads and feed and adjust vertically both tables as well as the entire top section.

Each machine, as regularly furnished, is so arranged as to be driven either by belted or by direct-coupled motors. The pulleys on the end of the heads also form the universal couplings so that by merely placing the motor brackets and motors each head can be direct driven. The power for the motor-driven machine is furnished by a 10-hp., 3,600 r.p.m. motor coupled to the bottom head; a 15-hp., 3,600 r.p.m. motor coupled to the top head, and a 7½-hp., two speed, 600 and 1,200 r.p.m. motor connected to the feed mechanism with a chain and sprockets. All three motors are provided with push button automatic control, having the push buttons mounted on the front bed convenient to the operator. The two-speed motor has a high, low and stop push button.

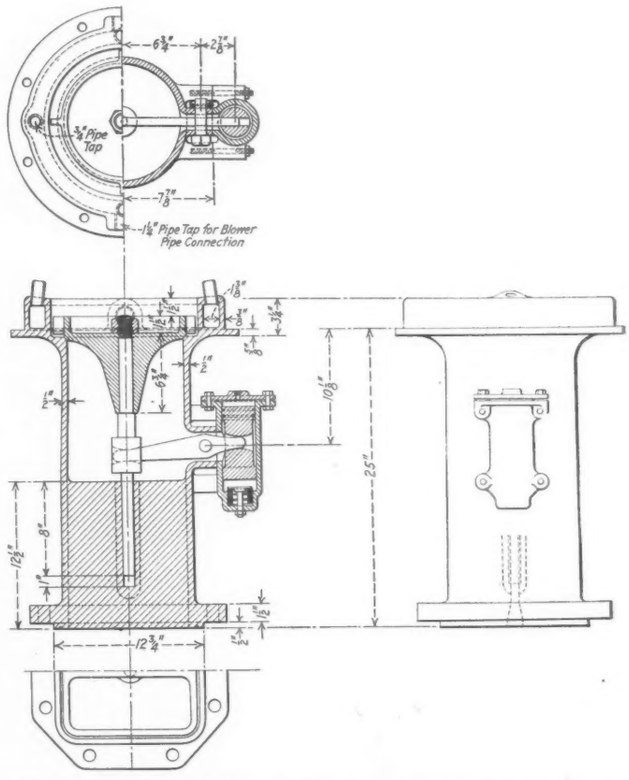
Locomotive exhaust pipe for braking trains

PATENTS have recently been granted to J. E. Osmer, Huron, S. D., on a locomotive exhaust pipe designed to operate in conjunction with a control valve, the function of which is to control a valve in the exhaust pipe which regulates the escape of exhaust steam from the cylinders and by means of the back pressure set up, retards the train.

The exhaust pipe tip, body and base are in one casting. A seat has been provided at the tip or nozzle for a valve. The body of the valve is designed with a contour that provides a variation of nozzle opening according to the height it is raised from the seat. The mechanism for raising the valve operates automatically when the throttle is opened and the valve reseats itself as soon as the throttle is closed. The closing of the exhaust nozzle as soon as the steam is shut off prevents cinders, and gases, injurious to lubrication, from being drawn into the steam chests and cylinders.

A feature of the device is that it can be used to control the speed of a train without the use of the air brake. A connection is made in the smokebox by a ½-in. pipe from the steam pipe to a steam cylinder on the exhaust pipe. Referring to the drawing of the exhaust pipe, it will be noted that the exhaust pipe valve is fitted with a stem which extends vertically down into a hole drilled in the dividing partition between the exhaust passages. A lever arm, operated by the piston in the small steam cylinder bolted to the exhaust pipe casting, engages the exhaust valve stem. A downward movement of the piston will raise the exhaust valve and vice versa. The piston is forced down by the steam which is carried to the top of the exhaust pipe cylinder by the ½-in. pipe. In order to raise the exhaust pipe valve the throttle must be opened.

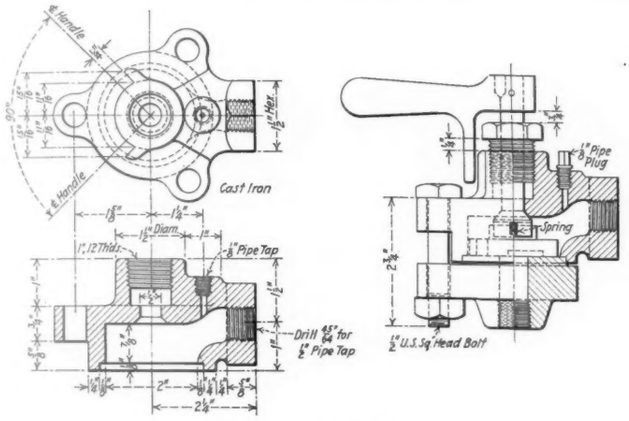
The exhaust pipe valve may be closed when the throttle is open by admitting steam at the bottom of the cylinder which forces the piston up and the valve down. Steam for this purpose is taken direct from the boiler through the control valve, a drawing of which is also shown. A ½-in. pipe is used to carry the steam from the control



An exhaust pipe which is closed by a valve when the locomotive is not working steam

valve, which is located in the cab near the air brake valve, to the exhaust pipe cylinder.

The closing of the exhaust pipe valve causes steam



The control valve

to be retained in the cylinders. This results in back pressure being built up, the amount of which may be controlled by the control valve and throttle. A gage is provided by which the engineman may know what pressure has been built up at the control valve and proper reduction may be made as deemed necessary. Braking is accomplished by means of the back pressure thus created. If it is desired to stop the locomotive, steam is admitted to the bottom of the exhaust pipe cylinder by means of the control valve, which holds the exhaust pipe valve in its seat. This confines the steam to the cylinders and builds up a high back pressure. In order to slacken speed, the throttle is opened wide which admits steam to the top of the exhaust cylinder and causes the exhaust pipe valve to rise, and the valve gear is placed in full travel position. The degree of the upward movement of the exhaust valve is regulated manually by the pressure on the bottom of the exhaust pipe cylinder piston. The engineman is thus able to control the amount of cylinder back pressure by adjustment of the throttle and control valve. The partial vacuum created within the cylinders when coasting with the throttle shut off tends slightly to bunch the train and at the same time to prevent pounding of the revolving and reciprocating parts.

Slipping while ascending a grade may be prevented by moving the handle of the control valve to "set" position, with the throttle left open.

Reversible placard holders for tank cars

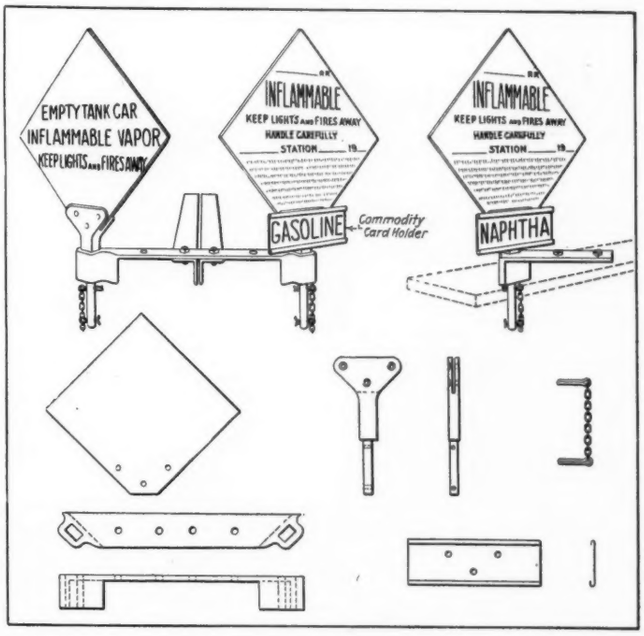
FOR the past several years the question of the application and removal of placards has been a live issue with the oil and other industries operating tank cars for transporting dangerous commodities. The device shown in the illustration, patented and marketed by E. A. Fall, 90 West St., New York, is designed to effect an improvement in existing conditions. The line drawing shows in detail the construction of the reversible placard holder and placard, assembled and knocked down. The general principles of the design have been approved by the Bureau of Explosives, and its application to tank cars is permissible under the rules and regulations set up and enforced by the Interstate Commerce Commission.

The base of the holder, shown in two forms, double and single, can be applied to the car in either form. Where the double base is used, it is applied diagonally across the steel sill brace at the corner of the car. This method immediately brings the two placards into proper location to serve the side and end running boards, insuring sufficient clearance of the placards from the running board to prevent the possible tripping and stumbling of trainmen. Where the single base is specified, the application of separate bases to the side and end running boards also insures sufficient clearance to avoid possible accident.

The upper part of the stem or shank has a rounded flare, which tends to strengthen the placard after the latter is placed in the slot in the head of the stem and securely riveted to prevent shifting. The center part of the shank is square in section and slightly tapered, while the bottom section is round, permitting free movement up and down. The lower section of the shank is provided with holes for the insertion of cotter pins whereby the placard is held in the desired position permanently or temporarily.

The base and shank of the holder are malleable iron, while the placard is 16 gage Armco iron, enamelled on both sides, which makes the holder and placard practical and durable for the class of service for which it is intended. The commodity car holder can, if desired, be quickly and easily applied at the time the placard is riveted to the shank.

The placard has printed on one side the information necessary when a tank car is loaded with an inflammable



Detail construction of reversible placard holder, assembled and knocked down

liquid and on the other the notice required when the car has been emptied of its contents. Thus, one placard serves the car when loaded or empty merely by reversing it in its holder to bring to the front whichever side is required.

Circular cross-cut and rip saw filer

WOOD-CUTTING saws of various types are used extensively by the railroads and in order to obtain maximum efficiency from them the saw blades must be frequently sharpened in the proper manner. The Wardwell Manufacturing Company, Cleveland, Ohio, has recently placed on the market a combination cross-cut and rip circular saw filing machine. It has a range of capacity for sharpening all cross-cut and rip circular saws up to 18 in. diameter, with teeth from the smallest up to ½ in. from point to point at a speed of 65 teeth per minute.

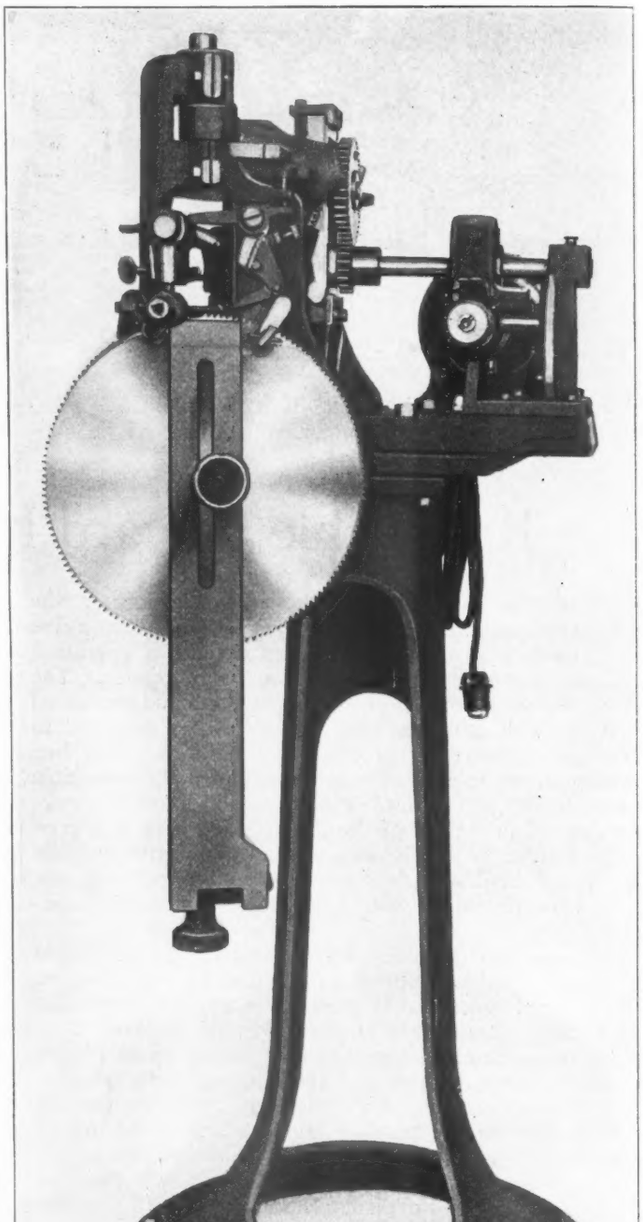
The frames, pulleys and the horizontal slide that carries the file are made of gray cast iron. The cam shaft bracket is babbitted and the swivel head bearings are fitted with radial adjustments. The vise contacts and all parts subjected to wear are made of steel. The filing arm works between heavy adjustable bronze gibs which insures accuracy.

The machine is automatic after starting. The bevelling of the cross-cut saw teeth is secured by the automatic swivelling of the vise frame holding the saw. The amount or degree of bevel can be regulated and adjustments can be made for saws of varying gages. The machine can handle three different degrees of bevels. Through the elliptical movement of the filing arm any hook of tooth can be filed and all teeth can be sharpened without a particle of a burr.

The operation of the machine is simple. To the main drive shaft is connected a cam which raises the slide frame at a slight angle out of the vertical, which gives an oblique movement to the file the same as in hand filing, and allows the file to enter and leave any hook of tooth. On the point of the cam is a hardened steel roller which operates the horizontal slide filing arm. Two adjustments cover the movement of the pawl lever attached to the swivelling head frame and rocked by a riding rod on the filing arm. One of these adjustments covers the length of stroke and the other the amount of cut removed from the face of the tooth. One elevating screw raises or lowers the saw at the point of filing. The saw is gripped rigid during the filing stroke, then is automatically released as the filing arm raises, thus paralleling the movement of hand filing.

The swivelling movement of the head and saw vise is secured through a two to one gear connection from the main drive shaft. The saw is turned alternately right and left to an amount depending on the number of degrees of bevel to be given the teeth. The teeth of crosscut saws are thus consecutively sharpened with alternate bevels through the swivelling of the saw between each stroke of the file. Rip saws, the teeth of which do not require bevelling, are filed straight across by slipping the gears out of mesh and tightening the vise head in position at right angles to the file. The saw vise is easily removed for cleaning when necessary. The saws are fed through a pawl movement. When this pawl or feed finger is allowed to feed one tooth behind the one that is being filed, the teeth are all jointed.

The machine shown in the illustration is mounted on a pedestal and is direct connected to a motor. The base is a casting, which supports both the motor and the machine. One cast iron bracket supports the end of the main drive shaft as well as the end of the shaft extending from the motor. A hardened cut worm and gear are used which run in an oil bath. A universal, flexible coupling permits of easily removing the motor as well as relieving the pressure on the armature. Each machine is furnished with a motor fully equipped with insulated wire and a plug for attaching to a lamp socket by a snap swivel. All the motors are self starting and driven from a lamp socket of light current.



Wardwell saw filer with direct connected motor, mounted on a pedestal

The speed of the motor is 70 r.p.m. If belt driven the pulley is 10 in. by 1¾ in. The machine requires a bench space of 12 in. by 10 in. The weight of the machine without the pedestal is 85 lb.

Universal cutter and tool grinder

A UNIVERSAL cutter and tool grinder suitable for the toolroom has recently been placed on the market by the Wilmarth & Morman Company, Grand Rapids, Mich. It can be furnished with either a belt or motor drive. The belt drive can be converted into a motor drive at any time by replacing the main head. In eliminating the belt drive the head or table can be swung 360 deg. Two motors are furnished, a ½-hp. motor on the main head and a ⅛-hp motor on the head stock.

Motor driven universal cutter and tool grinder

The machine contains several improved features. The longitudinal feed may be controlled from the front or rear of the machine. The micrometer adjustment of the table can be put in use at any angle of the table. The knee is supported by the full circumference of the column which is fully protected from dust and grit. The saddle is also constructed so as to protect all working parts underneath from dust and grit. All movements on the machine are provided with taper gibs or adjustable take-up nuts. All the attachments which go with the machine are interchangeable with the No. 1 universal grinder manufactured by this company.

The following are some of the specifications of the machine: The longitudinal, vertical and transverse movements of the table are 16 in., 8 in., and 8 in. respectively. The centers will swing work up to 10⅜ in. in diameter by 20 in. long. The internal grinder attachment has a speed from 9,000 to 18,000 r.p.m. and will grind from 9/16 in. diameter up, 3 in. deep and from 1¼ in. diameter up, 5 in. deep. The universal attachment will swing cutters 16 in. in diameter over the table and 24 in. in diameter over the sub-table. The gear cutter attachment will cut 120 pitch to one pitch in gear blanks ranging from 1¾ in. to 8½ in. in diameter. The steady rest and chuck have a capacity of 2½ in. and 4 in., respectively. The tilting and swivel vise base opens 2⅜ in. and the jaws may be temporarily removed, increasing the opening ¾ in. The table has a working surface of 5½ in. by 32 in. The spindle speeds are 3,000 and 6,000 r.p.m.

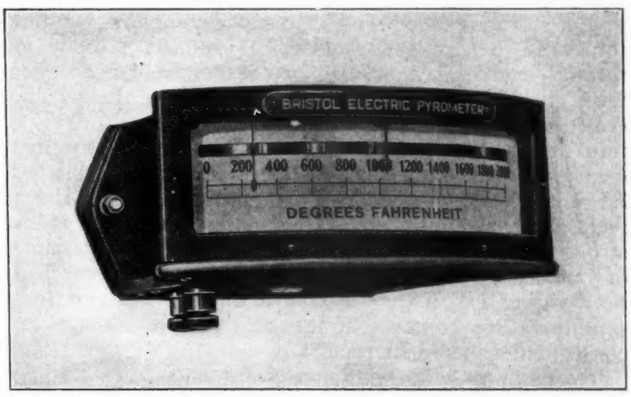
High resistance indicating pyrometer

THE Bristol Company, Waterbury, Conn., has recently placed on the market a new model high resistance indicating pyrometer. It has a scale seven inches wide which permits the pyrometer to be easily read at a considerable distance from it. As a further aid to easy visibility, a combination pointer is provided, having a broad section for distance reading and a knife blade section for accurate close-up work. In addition to these features, the scale is also provided with a mirror, which eliminates any possible errors in reading due to parallax.

A high resistance Weston millivoltmeter is used for the measuring element which is equipped with an accurately balanced moving coil and pointer. It has a resistance of 15 to 20 ohms per millivolt. An automatic cold-end compensator is provided to give an accurate scale reading without the necessity of making allowance for a correction.

There is an unavoidable variation of temperature in the pyrometer itself which influences the correctness of the reading. This factor has been taken into consideration when designing the instrument so that any effect of temperature changes on the accuracy of the pyrometer is minimized.

The case is made of cast aluminum and is of dust-proof construction. It is arranged for wall or switchboard mounting, having a demountable base for separately bolting to the wall and supporting the instrument. A small adjusting screw on the outside of the case provides an easy means of zero adjustment. A knob on the top of the case makes it possible to set the normal index spotter for the temperature desired for each individual piece of work.

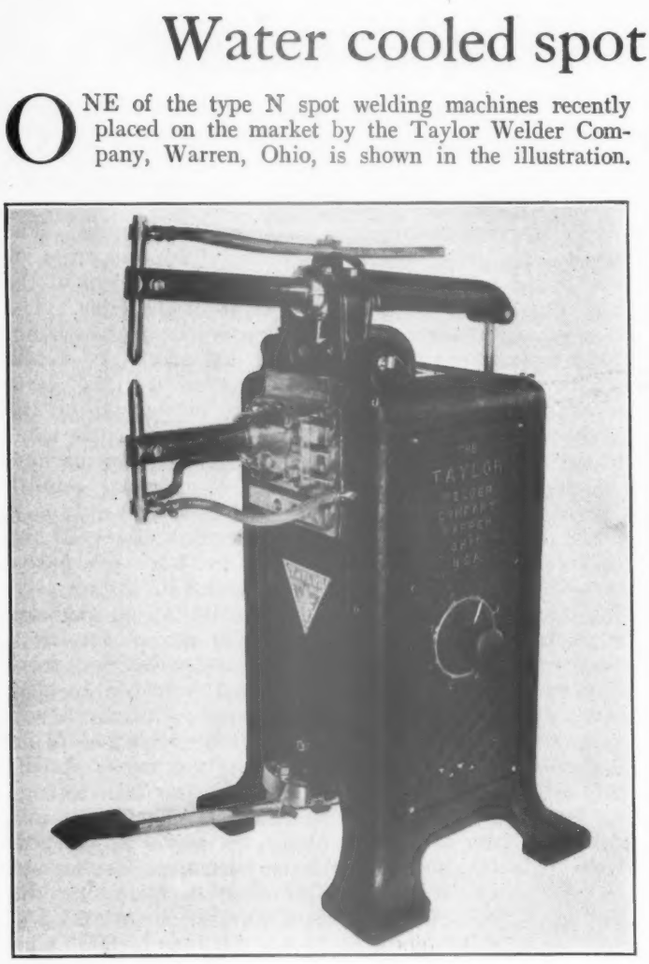


Bristol high resistance indicating pyrometer with an exceptional range of visibility

The pyrometer can be furnished for all ranges up to 5,000 deg. F.

Water cooled spot welding machine

ONE of the type N spot welding machines recently placed on the market by the Taylor Welder Company, Warren, Ohio, is shown in the illustration.



Taylor spot welder provided with adjustable horns

This machine is built in three sizes for welding work ranging from No. 30 gage material to two plates 3/16 in. thick. The overhang is from 6 in. to 30 in. The upper horn is adjustable in and out to permit the use of gooseneck welding points with one of the regular welding points, and both horns can be revolved in either direction to allow welding in corners and otherwise inaccessible places. The lower horn is adjustable up and down and sidewise in either direction.

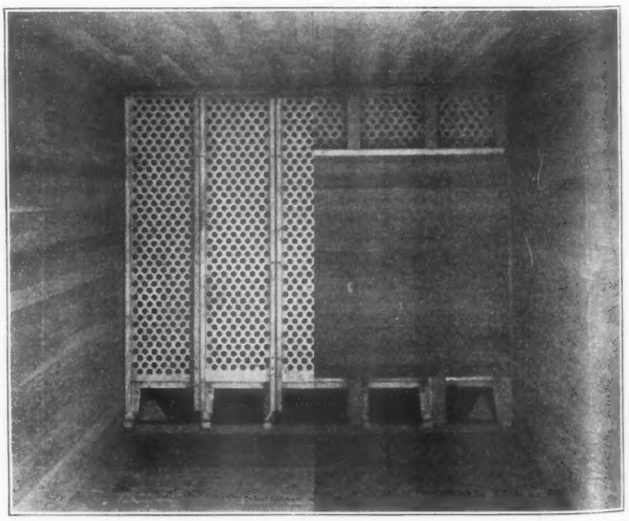
The smallest machine is equipped with a 10-kw. transformer, and the intermediate with a 15-kw. transformer. There is an eight-step self contained regulator for adjusting the current to take care of the lightest work up to the capacity of the machine. The switch is of an automatic and non-automatic type so designed that it cannot close until the electrodes have made proper contact with the work. No adjustments are required for different thicknesses of work or for wear of the electrodes. The switch is changed from an automatic to a non-automatic trip by operating a lever. The automatic trip is desirable for welding work that is buckled and does not fit together properly, as it permits a positive pressure to be applied to the weld after the current has been turned off, and thus prevents the weld from separating while in the molten state. It is desirable to set the switch in the non-trip position in welding wire and clean sheets, and also in operations where greater speed is wanted. The pressure on the electrodes is controlled by means of a hand-wheel.

In addition to the water circulation in the electrodes, the transformer is water cooled. The machine may be furnished with a quick change gear box and either a belt or motor drive. The foot-treadle is adjustable in or out and may also be swiveled to suit the convenience of the operator. The travel of the upper electrode and the foot-treadle can be varied for different thicknesses of work by means of a lever which is located on the front of the machine.

All-metal bulkhead and ice grate

THE Equipco all metal bulkhead and ice grate illustrated has been designed and constructed by the Equipment Specialties Company, Chicago, to give a strong, pilfer-proof ice compartment for refrigerator cars. The usual wooden ice grates are easily cut through with a saw or axe, or the bulkhead netting cut with clippers. Tools for this purpose are readily concealed about the person, and the thief merely drops down into the ice compartment and cuts through to the merchandise; no seals need be disturbed and he works where he cannot be seen. Besides preventing pilferage, the all metal bulkhead and ice grate is designed to provide a strong construction which will eliminate the breakage of bulkhead posts, due to shifting loads in the car body or wedging ice in the ice compartment. Both of these conditions are responsible for considerable damage and consequent expense in repairs.

The Equipco design consists of perforated metal sections which, when in place form a strong partition across the car. The posts are formed as integral parts of these sections. The tops of the sections are bolted directly to the ceiling and header, while the fastening at the floor is by means of post shoe castings secured to the floor rail. This gives the equivalent of an all steel end for refrigerator cars, located where it will afford the maximum protection, namely at the bulkhead and not at the car end as in the case of box cars. The actual trouble from shifting loads in refrigerator cars comes at the



Equipco all-metal bulkhead in refrigerator car—The left half of the wooden face of the bulkhead is cut away to show the perforated metal sections

bulkheads and not at the end walls of the refrigerator cars.

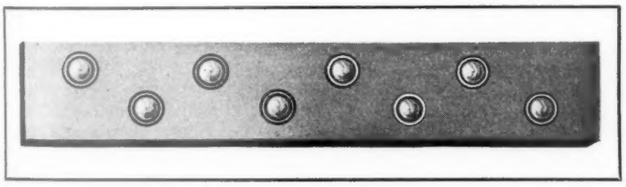
The so-called basket bunker generally used is maintained, but the piece of netting at the bulkhead is unnecessary as the perforated sections answer the same purpose. The sections are bolted to each other, and securely fastened to the side walls of the car.

The substantial pressed steel grates are individual bars, not made in sections as is the case with wooden grates. The grate bars are carried between the flanges of channel-shaped carriers, and they are locked in place by a key grate bar at the center. The fastening or lock for the key grate is accessible only from the inside of the car proper, and not from the ice compartment. Thus, unless this key grate is removed, none of the other bars can be disturbed. One of the illustrations shows a close-up view of the pressed steel grate bars and indicates how they are carried in the channels.

Further advantages claimed for the Equipco metal bulkhead and ice grate are minimum maintenance expense, easy application, and conformance to existing standards of ice capacity and distance between bulkhead faces. This equipment is already in service on three important refrigerator lines.

Ball parallels for use in drilling heavy work

BALL parallels for use in connection with the drilling or counterboring of heavy fixtures, jigs, dies and other heavy work are shown in the accompanying illustration. They are intended to permit the drill or counter bore to pull the work in line with the spindle.



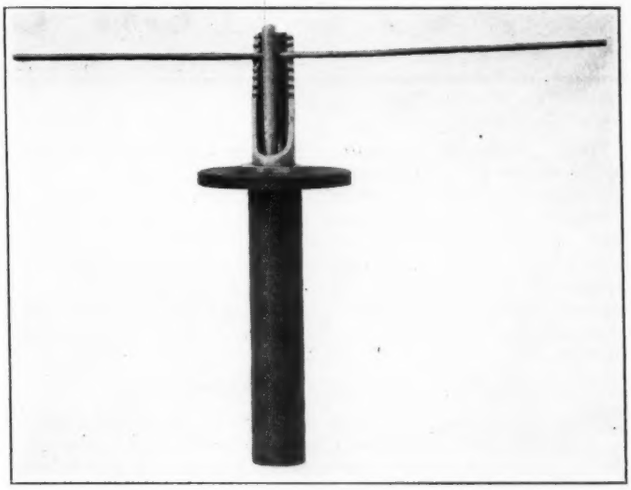
Ball parallels used in drilling heavy work

The manufacturer, the J. F. Smith Tool Company, Dayton, Ohio, is producing two sizes, one of which is 1 in. wide and 6 in. long and fitted with ¼-in. balls while the largest size is 1 in. by 7 in. and equipped with balls ⅜ in. in diameter.

Electrode holder for metallic arc welding

A NEW type of welding electrode holder, marketed by the General Electric Company, Schenectady, N. Y., allows welding operators to make a quick change from a burnt stub to a new electrode. The operator needs only to strike the stub end of the old electrode, causing it to drop out after which the new wire can be inserted without unnecessary effort.

The holder consists of a punched fibre tube with a tinned brass plug inserted in the end. A steel spring rod holds the electrode in place against one of a number of different sized notches provided for this purpose. The welding cable running to the source of power is soldered to the other end of the holder. The fibre tube and guard can be removed by loosening a single screw. The construction of this holder is such that the contact of



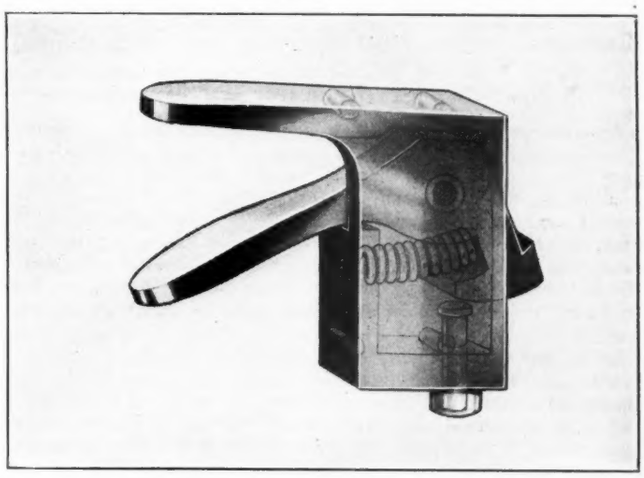
Electrode holder which permits a quick change of electrodes

the electrode is not weakened by heat, since it does not depend upon any heat-affected spring.

Combined sash lock and window opener

THE National Lock Washer Company, Newark, New Jersey, has placed on the market a unique device in the form of a combined sash lock and window opener.

From the illustration it will be noted that when the slightest pressure is imparted to the lower lever of the



Sash lock designed to open sticking car windows

sash lock, the lifting force is multiplied many times by a cam which pushes down a small plunger extending through the bottom of the sash lock case. This force is sufficient to start sticking or immovable windows. When the window has been so released it can be adjusted to any desired height in the normal way.

It is through the employment of a dowel and bolt construction that such a device is made possible. The phantom illustrations shown will give a clear idea of the construction of this device.

General News

Many aspects of the railroad problem were discussed briefly and pointedly in a bulletin distributed by the Atchison, Topeka and Santa Fe under the authority of W. B. Storey, president, as a New Year Greeting on January 1. The necessity for constant heavy expenditures for new equipment and facilities, the legislative situation in Congress, the employees and their wages, freight rates, increases in transportation costs, competition with motor trucks, and the necessity of efficiency in the use of equipment were discussed in the bulletin.

Soo line offers prizes for shop ideas

Six prizes totalling $100 have been offered by the Minneapolis, St. Paul & Sault Ste. Marie to its employees in the car and locomotive departments for the best ideas for improving and facilitating shop practice. First prizes of $25, second prizes of $15 and third prizes of $10 are offered to the employees of each department. The competition will close on April 1.

Southern Pacific lines offer safety prizes

Foreman of the maintenance of way, mechanical, stores and station service departments of the Southern Pacific, Texas and Louisiana lines, are eligible for prizes of $15 each, to be paid shortly after December 31, 1925, if they can complete the year without a single reportable accident in their gangs. The $15 prize is the minimum and applies to foremen in charge of gangs working 20,000 man-hours or less during the year. The prize is increased at the rate of $15 for each 40,000 additional man-hours worked without reportable accidents up to a maximum prize of $105, except that, regardless of the size of the gang, foremen having three or more reportable accidents are not eligible for any prize. This competition is open to all foremen of the maintenance, mechanical and stores departments whose gangs work more than 10,000 man-hours during the year, and foremen of warehouse and transfer gangs working 20,000 or more man-hours during the year.

Status of automatic train control orders

In addition to the railroads that have been allowed by the Interstate Commerce Commission an extension of time in which to complete their installation of automatic train control on a division as required by the commission's order of June 13, 1922, there are several roads that have not filed any petition for an extension of time, or whose petitions, if filed, have not yet been acted upon by the commission. Most of the roads have been granted extensions and four have been denied, but in addition the installations on the Atchison, Topeka & Santa Fe; Chesapeake & Ohio; Chicago & Eastern Illinois; Chicago, Rock Island & Pacific; Philadelphia & Reading, and Southern Pacific are regarded as completed, or practically so. The Atlantic Coast Line has filed a petition for an extension on which the commission has not yet announced its decision, and it is understood that the Chicago, Milwaukee & St. Paul; Long Island, Pennsylvania, and West Jersey & Seashore have not yet filed petitions for an extension.

The Chicago, Burlington & Quincy has petitioned the commission for an extension of time to June 30, 1925, to complete the automatic train control installation. The company has let a contract to the Sprague Safety Control & Signal Company which guarantees compliance with the commission's specifications.

The Richmond, Fredericksburg & Potomac, one of the four roads to which the Interstate Commerce Commission refused an extension of time beyond January 1 in which to complete the installation of automatic train control, has filed a petition with the commission for a rehearing. The petition says the road is a "bridge line" transferring the passenger and freight trains of six large roads and that therefore it is especially important that it have the best device obtainable. After the commission had authorized preliminary tests of 20-mile sections the company had contracted with the Union Switch & Signal Company on August 11 for an installation between Richmond and Doswell, Va., 20 miles, and expects to be in a position to request a preliminary inspection by the commission some time in March.

The Interstate Commerce Commission has granted the petition of the Richmond, Fredericksburg & Potomac for an extension of time in which to complete its automatic train control installation to July 1, although this was one of the four roads for which the commission had previously denied an extension. The commission has also granted an extension to July 1 on petitions filed since the first of the year by the Pennsylvania; the Pittsburgh, Cincinnati, Chicago & St. Louis; the West Jersey & Seashore and the Atlantic Coast Line.

The Central of New Jersey, which was also one of the four roads denied an extension of time, has filed a new petition asking for a reconsideration and for an extension to September 1.

New York Central to give lectures on railroading

Following a request from members of the New York Central Athletic Association at Rochester, N. Y., the New York Central has arranged for a course of lectures to be given on the science of railroading. The lectures will be in the nature of university extension courses and members will be invited to prepare papers on the subjects treated in each lecture for which prizes will be awarded. The lectures will be given on the last Thursday of each month.

On January 29 T. W. Evans, assistant vice-president of operation, lectured on the part played by the railroads in the economic life of the nation. On February 26 F. E. Williamson, general superintendent of the New York terminal district, will speak on transportation and supervision. On March 26 W. C. Wishart, controller, will speak on railroad financing and accounting. On April 30 G. W. Kittredge, chief engineer, will speak on the principles of railroad location and construction. The course will include lectures on locomotive and car design by F. H. Hardin, chief engineer of motive power and rolling stock; the maintenance of locomotives and cars by R. M. Brown, assistant superintendent of motive power; and on the maintenance of tracks, bridges and buildings, by J. V. Neubert, engineer maintenance of way. In addition, the faculty of Rochester University will participate.

Court news

FUSIBLE PLUGS NOT ESSENTIAL IN CROWN SHEETS UNDER BOILER INSPECTION ACT.—Action was brought in the federal district court for the northern district of Ohio, under the Federal Employers' Liability Act and the Boiler Inspection Act, against the Baltimore & Ohio for damages for the death of an engineman killed by an explosion of the boiler of his engine.

The trial court submitted for decision of the jury two issues: whether the explosion was caused in whole or in part by an unsafe and insufficient condition permitted by defendant in and about the crown sheet of the boiler; and, whether defendant's failure to have a fusible plug in the crown sheet violated Sec. 2 of the Boiler Inspection Act. Verdict and judgment were rendered for plaintiff. The Circuit Court of Appeals, Sixth Circuit, affirmed the judgment (288 Fed. 321), and the case was taken to the United States Supreme Court on certiorari.

1. The railroad asserted that Sec. 2 of the Boiler Inspection Act prescribes no definite or ascertainable standard of duty. The United States Supreme Court holds that the requirement of the statute "is as definite and certain as is the common law rule: and to hold that the duty imposed cannot be ascertained would be to declare that the common law rule which is ordinarily applied in personal injury actions brought by employees against employers is too indefinite to be enforced or complied with." This contention was therefore held to be without merit.

2. The railroad averred absence of evidence that the explosion

resulted from any defective or dangerous condition of the crown sheet.

There was no fusible plug in the crown sheet. The Supreme Court holds that Rule 25, approved by the Interstate Commerce Commission, does not purport to require fusible plugs to be used. It was shown that the boiler had seven broken staybolts, and that they had been broken some time before the day the explosion occurred; and it is held that use of the boiler in that condition violated Rule 25; but it was not shown what caused these to break. All persons on the engine—engineer, fireman and brakeman—were killed. The train had stopped for water at Foster's Tower, about three miles from the place of the explosion. A brakeman employed on another train, then at that station, testified that he went into the cab of this engine, and that, while there, he observed that water and steam were escaping from the boiler into the firebox; that he heard the sizzling of the water upon the fire; that, when he opened the firebox door, steam gushed out; that the fire was dead; that the steam gage showed 160 lb. pressure, and that water was being put into the boiler by the two injectors. The location of the broken staybolts in relation to the place of rupture was shown to be such that the explosion was not caused by them. But the court agreed with the Circuit Court of Appeals that, under Sec. 2 of the statute, there was sufficient evidence to sustain the verdict, wholly apart from the broken staybolts. The railroad was liable if its breach of duty contributed to cause the death. The credibility and weight of the brakeman's testimony as to the condition of the boiler at Foster were for the jury; and if the boiler was in the condition he described, it was held that it would not be unreasonable to conclude that a breach of duty of the railroad caused or contributed to cause the explosion. It did not conclusively appear that the failure of deceased properly to operate the engine was the sole cause of the explosion, so the evidence made a case for the jury.

3. The Supreme Court holds that the trial court erred in instructing the jury that the defendant was bound to avail itself of "the best mechanical contrivances and inventions in known practical use which are or would be effective in making safe a locomotive boiler as against explosions," and also erred in authorizing the jury to decide that "the standard of duty imposed by the law required a fusible safety plug to be installed." The carriers were left free to determine how their boilers should be kept in proper condition for safe use. The things required for that purpose were not prescribed or changed by the act. Defendant was not liable for failure to furnish the best mechanical contrivances or to discard appliances upon discovery of later improvements. * * * It is not for the courts to lay down rules which will operate to restrict the carriers in their choice of mechanical means by which their locomotives are to be kept in proper condition. The presence of absence of a fusible plug was a matter properly to be taken into consideration in connection with other facts bearing upon the kind and condition of the boiler in determining the essential and ultimate question, i. e., whether the boiler was in the condition required by the act."

Judgment for plaintiff was reversed.—Baltimore & Ohio v. Groeger. Decided January 5, 1925. Opinion by Mr. Justice Butler.

"B. & O. Plan" being put into operation in Moncton shops of C. N. R.

Steadier employment, better working conditions, greater output and improved service to the public are expected from the application of the "Baltimore & Ohio plan" which will be put into operation in the Canadian National shops throughout the Dominion. At the present time Captain O. S. Beyer, consulting engineer for the Railway Employees' Department of the A. F. of L. at Washington, is in Moncton, N. B., headquarters of the Atlantic Region of the Canadian National Railway, making the necessary arrangements. Surveys carried on for some months have been completed and at a recent meeting Captain Beyer addressed the men in Moncton and was given a cordial reception. When the plans are completed questions of interest to the management and the men will be dealt with through committees, which are already in existence, but which in the past have concerned themselves only with grievances.

Western roads settle with enginemen

Settlements on wage increases and changes in working rules for engine service employees have now been made by virtually all of the larger western railroads during the past week. The settlements in general follow the lines of the agreement of the Southern Pacific with its enginemen, which granted a wage increase of approximately 6 per cent, with minor changes in working rules.

The revisions of working rules made by the various roads are as follows. The Gulf, Colorado & Santa Fe adopted a 20 mile-an-hour speed basis for computing overtime in passenger service and adopted rules providing for no duplication in payment for arbitraries or special allowances with passenger road overtime; covering emergency side or lap back trips between terminals; and covering emergency short trips into and out of terminals in connection with their own trains. The wording in doubling hills and tonnage rules was also changed so that the management may avoid making ratings of engines over entire districts and giving the management an opportunity to change ratings at points where grades break in a district. The dead-head rule was also amended so as to provide that no compensation would be allowed for dead-heading resulting from the limitation of the Chicago joint working agreement. On the Chicago & North Western, a rule was adopted providing for emergency short runs in and out of terminals in connection with all trains to be paid continuous time or mileage when made under conditions such as engine failure, running for fuel or water, running for wreck car or carmen or on account of derailment. Rules were also adopted providing that in emergency combination hostler and road service or emergency com-

LOCOMOTIVE REPAIR SITUATION

Date, 1924	No. locomotives on line	No. serviceable	No. stored serviceable	No. reg. classified repairs	Per cent	No. reg. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,588	17.9
July 1	64,416	53,382	7,117	6,035	9.4	4,999	7.7	11,034	17.1
October 1	64,538	53,209	5,424	6,175	9.6	5,154	8.0	11,329	17.6
January 1, 1925	64 384	53,118	4,849	5,927	9.2	5,339	8.3	11,266	17.5
February 1, 1925	64,308	52,994	4,220	6,143	9.6	5,171	8.0	11,314	17.6

Data from Car Service Division reports.

FREIGHT CARS ORDERED, INSTALLED AND RETIRED

Month 1924	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons	Building in R. R. shops
January	15,589	707,367	12,329	516,695	2,310,032	100,644,107	2,417
February	11,386	554,481	10,466	411,228	2,310,570	100,767,731	2,715
March	9,962	446,094	8,726	352,481	2,311,405	101,165,332	2,697
April	8,718	369,978	8,026	306,288	2,312,074	101,223,891	2,739
May	9,199	439,516	9,059	360,212	2,312,237	101,303,200	2,467
June	10,909	538,118	8,347	321,094	2,314,798	101,569,593	2,269
July	16,583	1,151,302	8,413	316,927	2,322,968	102,388,652	4,602
August	15,452	785,288	8,834	333,173	2,329,582	102,845,000	3,618
September	15,455	779,078	9,337	370,607	2,336,147	103,270,000	3,045
October	16,598	834,762	10,504	*418,816	2,342,149	103,688,000	*3,574
November	11,705	579,234	10,678	463,970	2,342,479	103,767,000	5,159
December	6,763	311,254	11,918	488,035	2,337,229	103,585,000	6,478
Total for year	148,319	.....	116,637				

*Corrected figure.

Figures as to installations and retirements prepared by Car Service Division A. R. A. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

bination hostler and yard service engineer or fireman will be paid for the entire service at the highest rate applicable to any class of service performed with a minimum of a day's pay for the combined service. On the Burlington, a rule was adopted providing that outside hostler's rate is not to apply on account of use of yard tracks supplying power with fuel, water and sand. Another rule was adopted that hostlers will be permitted to handle relief engines and be paid outside hostler's rates. The Los Angeles & Salt Lake revised several rules in accordance with the changes made by the Gulf, Colorado & Santa Fe.

Labor board decisions

The Railroad Labor Board has ordered the following wage increases in rates of pay of the clerical employees on the International-Great Northern represented by the Brotherhood of Railway and Steamship Clerks, Freight Handlers, Express and Station Employees: Storekeepers, assistant storekeepers, chief clerks, foremen and other clerical supervisory forces, two cents an hour; clerks with one or more years of experience, two cents an hour; clerks with less than one year's experience, one cent an hour; train and engine crew callers, assistant station masters, train announcers, gatemen and baggage room employees, two cents an hour; janitors, elevator operators and watchmen, one cent an hour; office boys and messengers, no increase; freight handlers and truckers, one cent an hour; sealers, scalers and inspectors, one cent an hour above truckers' rates; stowers, loaders and coopers, two cents an hour above truckers' rates; common laborers, an increase of two cents an hour; telephone switchboard operators, no increase.—*Decision No. 2784.*

The Railroad Labor Board has decided that an employee who is regularly assigned to positions with Sundays off shall be paid time and one-half for work performed on Sundays while working temporarily in place of another employee whose relief day is other than Sunday. The employee shall not be required to lay off on the relief day of the employee whose position he is filling temporarily if he desires to work.—*Decision No. 2892.*

New York Central employees buy twelve millions of stock

The New York Central announces that 41,570 employees have accepted the company's offer of stock in the corporation at 110, which is about $12 per share below the market price. Stock worth more that $12,000,000 was subscribed for. Approximately one employee out of every four on the system is on the list of subscribers and the number of common stockholders is more than doubled. Originally the offer was limited to 35,000 shares but 68,747 additional shares were later added.

All subscriptions for one or two shares will be filled under the allotment plan. Subscribers for three or four shares will receive two shares; subscribers for five to eight, three shares; nine to twelve, four shares; thirteen to sixteen, six shares. Payment is to be made in monthly installments. Before this offer was made the New York Central had 36,500 stockholders. There will now be about 78,000. Subscriptions from the various roads in the system were: New York Central, 23,689 individuals; Big Four, 8,821; Michigan Central, 3,624; Indiana Harbor Belt, 1,919; Chicago Junction Railway, 1,472; Pittsburgh & Lake Erie, 1,234; Boston & Albany, 811. Subscriptions for one share were received from 23,103 employees; for two to five shares from 15,963 employees; six to ten shares, 1,757 employees, and eleven to twenty shares, 747 employees.

Wage statistics for November

Class I railroads reported for the month of November, 1924, a total of 1,788,723 employees, a decrease of 33,893, or 1.9 per cent as compared with the returns for October, 1924, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. This reduction in employment is largely attributable to seasonal reductions in the maintenance of way and structures forces. The total compensation decreased $19,421,725, or 7.6 per cent. The difference between the per cent of decrease in compensation and that in employment is explained by the fact that there were only 24 working days in November, while there were 27 in October. Compared with the returns for the corresponding month last year the employment shows a decrease of 5.8 per cent and the compensation a decrease of 5.5 per cent.

Meetings and Conventions

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting May 26-29, inclusive, Alexandria Hotel, Los Angeles, Cal.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Business meeting to be held in Chicago June 16, 17 and 18. No exhibit of railway supplies and machinery will be held.

Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago. Next meeting September, 1925.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting May 19, 20 and 21, at St. Louis, Mo.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention August, 1925, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third street, New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting, June 22-26, Chalfonte-Haddon Hall, Atlantic City, N. J..

Association of Railway Electrical Engineers—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel Sherman, Chicago.

Canadian Railway Club.—C. K. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday each month, Hotel Statler, Buffalo, N. Y. Next meeting March 12. Paper on Uniform Interpretation of National Demurrage Rules and Charges will be read by J. F. Chalfaut, manager, department of demurrage supervision, A. R. A. Interim meeting April 9. Paper on Milling in Transit, Mixing in Transit and Reconsigning by W. B. Ewington, freight agent, Nickel Plate, Buffalo.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland. Next meeting March 20. Discussion A. R. A. rules.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill. Next annual convention May 26-29, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

Master Boiler Makers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 19-25, Hotel Sherman, Chicago.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting March 10. Forty-second annual meeting. Election of officers; reports. Address by Judge J. W. Redmond, general counsel, Central Vermont.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal. Next meeting March 12, Hotel Oakland, Oakland, Cal. Paper on Railroad Public Relations will be read by Ben S. Allen, director of public relations, Key System Transit Company. Railroad Advertising will be discussed by Charles W. Duncan, advertising counsellor, Foster & Keliser. Election of officers.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in each month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineer's Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 15-18, 1925, Chicago.

Western Railway Club.—Bruce V. Crandall, 189 West Madison St., Chicago. Next meeting March 16. Paper on Training of Apprentices will be read by C. G. Juneau, master car builder, C. M. & St. P.

Supply Trade Notes

The Chicago Metal Packing Company, Chicago, has changed its name to the Chicago Rhopac Products Company.

The Pantasote Company has removed its New York office from 11 Broadway to 250 Park avenue, New York City.

The Moline Foundry Company, Moline, Ill., has changed its name to the Moline Foundry & Machine Company.

The Weston Electrical Instrument Company, Newark, N. J., has changed its name to the Weston Electrical Instrument Corporation.

Harry S. Smith has been appointed railroad sales representative for the McMaster-Carr Supply Company, with headquarters in Chicago.

C. F. McCuen, formerly general sales agent of the Camel Company, Chicago, has been placed in charge of sales of W. H. Miner, Inc., Chicago.

W. R. Danley is now president of the Roto Company, Hartford, Conn., makers of boiler tube cleaners. Mr. Danley succeeds J. D. Cherry, who died on January 3.

James F. Twohy, secretary of Twohy Bros., railroad contractors, Seattle, Wash., has been elected vice-president of the Pacific Car & Foundry Company, Seattle, Wash.

W. R. Danley is now president of The Roto Company, Hartford, Conn., makers of boiler tube cleaners. He succeeded as president J. D. Cherry, who died on January 3.

A. S. Taylor, formerly sales engineer of the United Alloy Steel Corporation, Canton, Ohio, is now sales engineer of the Central Steel Company, Massillon, Ohio.

The Orton & Steinbrenner Company, Chicago, has appointed the William M. Bailey Company, Pittsburgh, Pa., representative for Pittsburgh and surrounding territory.

Lawrence Wilcox has been appointed representative in charge of the Columbus, Ohio, district of the Westinghouse Air Brake Company, to succeed S. D. Hutchins, deceased.

Glenn Grenville Howe, for many years senior vice-president of the Link-Belt Company, Chicago, died on December 25, at his home, in Muskegon, Mich., after a long illness.

John Y. Sloan, sales agent of the Pullman Car & Manufacturing Corporation, with headquarters at Chicago, has been promoted to manager of sales, with the same headquarters.

A. C. Cook, general sales manager of the Warner & Swasey Company, Cleveland, Ohio, has been promoted to vice-president and has been elected a member of the board of directors.

Norman J. Keyser, traffic manager for the Buffalo Forge Company, Buffalo, N. Y., has resigned to become head of the traffic division of the Kardex Company, at Tonawanda, N. Y.

James F. Hamilton, engineering and sales representative of the Worthington Pump & Machinery Corporation, has been promoted to manager of the newly opened sales office in Milwaukee, Wis.

E. R. Kenner, assistant sales manager of the Wellman-Seaver-Morgan Company, Cleveland, Ohio, has been appointed special representative of the H. K. Ferguson Company, Cleveland, Ohio.

The Joseph Dixon Crucible Company, Jersey City, N. J., has removed its Boston, Mass., office from 49 Federal street to 80 Federal street, which is the new Chamber of Commerce building.

The Ralston Steel Car Company, East Columbus, Ohio, is planning the construction of a one-story addition to its main plant, a new axle and wheel building and a paint and waste storage building.

The Premier Equipment Corporation, Houston; Tex., has been organized to take over the Houston Railway Car Company and will repair, buy and sell locomotives, cars, and other railway equipment.

Carl A. Pinyerd, representative of the Safety Car Heating & Lighting Co., at Chicago, has been appointed district engineer in charge of engineering and service matters, with headquarters at Chicago.

Walter S. Austin, mill representative of A. M. Castle & Co., with headquarters at Chicago, has been appointed general manager of sales for the Los Angeles Iron & Steel Company, Los Angeles, Cal.

The Landis Machine Company of Waynesboro, Pa., manufacturers of thread cutting die heads and threading machinery, has opened an office in Detroit at 5928 Second boulevard, in charge of J. W. Frey.

C. L. Wilkins, representative of the Walworth Manufacturing Company, with headquarters in Chicago, has been promoted to manager of the railroad and industrial department, to succeed J. E. Walsh, resigned.

John Heller, whose appointment as sales manager of the International Oxygen Company, Newark, N. J., was reported in the February issue of the *Railway Mechanical Engineer*, has been elected secretary of the company.

Lynn W. Nones has been appointed eastern sales manager of the Diamond Power Special Corporation, in charge of the Atlantic Coast offices from Boston, Mass., to Charlotte, N. C., inclusive. His office is at 90 West street, New York.

The American Car & Foundry Company will remove its operating and auditing departments about May 1, from 165 Broadway to the sixth floor of 30 Church street, New York City. The executive and other departments will follow about May, 1926.

W. H. Wiewel, assistant general sales manager of the United Alloy Steel Corporation, Canton, Ohio, has been appointed district sales manager of the Standard Seamless Tube Company, with headquarters at New York, to succeed B. F. Bart, resigned.

Carter P. Whitcomb, assistant sales agent of the Griffin Wheel Company, Chicago, in the New England territory, with headquarters at Boston, Mass., has been transferred as sales agent to the Pacific Coast territory, with headquarters at San Francisco, Cal.

Herbert H. Moffitt has been appointed southeastern representative of the Union Railway Equipment Company, with headquarters at Washington, D. C.; S. Clyde Kyle and N. Elliott have been appointed Pacific coast representatives, with headquarters at San Francisco, Cal.

H. Barney Gegenbach has been appointed western sales manager of the Hale-Kilburn Company, Philadelphia, Pa., in charge of its western sales office in Chicago. Mr. Gegenbach has been serving as acting western sales manager for over a year, since the death of Harry R. Rochester.

At a special meeting of the board of directors of the American Car & Foundry Export Company, New York, Oscar B. Cintas was elected a vice-president and director succeeding Charles S. Gawthrop, deceased. Mr. Cintas until his recent election was representative for the company in Cuba.

William R. Van Nortwick, who for the past seven years has been district sales manager at New York for the Roto Company, Hartford, Conn., has severed his connections with that company. Mr. Van Nortwick has opened offices at 50 Church street, New York, for the sale of material to buyers in the combustion field.

The Electric Arc Cutting & Welding Company, Newark, N. J., has opened a branch office at Syracuse, N. Y., in charge of William P. McCarthy. This office is completely equipped to handle all sales and distribution of welding machines and supplies for the entire state, exclusive of the Metropolitan district.

N. A. Campbell, field representative of the New York Air Brake Company, New York, died suddenly in Boston, Mass., on February 4, at the age of 60. He had been connected with the New York Air Brake Company for 25 years as field representative, originally in the western territory, but in recent years he covered the New England territory.

The Harnischfeger Corporation, Milwaukee, Wis., has moved its Atlanta, Ga., office to 303 Peninsular Casualty building, Jacksonville, Fla. W. J. Dugan, southern sales manager, will be in charge of the office and F. W. Truex, sales engineer at Atlanta, has been transferred to Jacksonville. G. H. Lillard and H. A. Wolcott have been appointed sales engineers, with headquarters at Jacksonville.

Willard D. Smith has been appointed manager of railroad sales of the Davis Boring Tool Company, St. Louis, Mo. C. C. Koeln, formerly in charge of production, has been transferred to the New York territory to take charge of eastern sales. Mr. Koeln should be addressed at the home office in St. Louis until his headquarters have been definitely located in the east.

Lewis O. Cameron, Munsey building, Washington, D. C., has been appointed district representative of the General American Car Company, Chicago. Mr. Cameron will handle sales on the southeastern railroads. He was formerly with the Pressed Steel Car Company, and for the last few years has been representing railway equipment companies in Washington.

Lynn B. Easton, manager of the Laidlaw works of the Worthington Pump & Machinery Corporation, New York, died at Cincinnati, Ohio, on January 24 at the age of 40. Mr. Easton had served for over 20 years at Laidlaw, in the sales department of the corporation, having started as time clerk, and then held many positions until he became manager of the works.

J. E. Walsh, manager of the railroad and industrial department of the Walworth Manufacturing Company, with headquarters in Chicago, has been appointed vice-president of Warren Corning & Co., to succeed T. R. Riley, resigned. H. F. Freyberg, office manager of the Vacuum Oil Company, with headquarters in Chicago, has been appointed secretary-treasurer to succeed H. G. Cook, resigned.

The sales department of the Baltimore office of the Symington Company has been removed to New York and continues under the jurisdiction of R. H. Gwaltney, vice-president in charge of eastern and southern sales, with headquarters in the Woolworth building, New York. I. O. Wright, sales engineer, with office in the Maryland Trust building, will continue to represent the Symington Company on the railroads having their principal offices in Baltimore. C. R. Naylor, sales agent at 2108 Straus building, Chicago, has been appointed manager western sales.

Charles J. Graham, vice-president of the Graham Bolt & Nut Company, Pittsburgh, Pa., who in December bought the Gould Coupler Company and the Gould Storage Battery Company from Commodore Charles A. Gould, has disposed of his holdings to a group of New York bankers who are acting for the Symington interests. The new company will be the Gould Coupler Company of Maryland, and William S. Gould, vice-president of the old company, will be president of the new company. The policies of the old company will be continued under Mr. Gould's direction, and there will be no material change in the management. This statement is authorized by Charles J. Symington, president of the Symington Company.

Frederick C. Riddile, general manager of the Edgewater Steel Company, Pittsburgh, Pa., died on December 21 at the Columbia Hospital, Pittsburgh, after a short illness, at the age of 59 years. Mr. Riddile was born in Burgettstown, Pa. His early life was spent in Pittsburgh, and as a young man he entered the employ of the Oliver Iron & Steel Company, later becoming associated with the Latrobe plant of the Railway Steel Spring Company. He then went to Chicago Heights, Ill., as general superintendent of the Inter Ocean Steel Company, and since the organization of the Edgewater Steel Company in 1916 he has been its general manager.

E. I. Cornbrooks has been appointed sales manager of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., succeeding Benjamin G. Fernald, who has resigned on account of ill health. Mr. Cornbrooks has been connected with the company for nearly twenty years, serving first as chief draftsman in the hull department and later as superintendent of hull construction and superintendent of construction. He has had an important part in the development of the company's new products, including railroad equipment and large hydraulic turbines and accessories such as regulating gates, valves, penstocks and surge tanks.

L. D. Whitaker, who recently severed his connection with the United States Steel Corporation, has become associated with Ralph W. Payne in the railway supply business at Washington, D. C. He was born at Salisbury, N. C., on May 25, 1898. He was educated in the North Carolina public schools and is a graduate of Emerson Institute, Washington, D. C., and the Law School of George Washington University, also spending three years in the arts and sciences department of that institution. He was connected with the American Surety Company of New York, from 1914 to 1917, and then entered the Washington sales office of the United States Steel Corporation, where he has since been located with the exception of one year in the marine corps during the war.

Albert Waycott, founder and former president of the Damascus Brake Beam Company, Cleveland, Ohio, died on January 15 in a hospital in San Francisco, Cal., following an attack of heart disease, which occurred while he was returning from a trip to Panama. He was born in St. Andrews, New Brunswick, and came to St. Louis, where he organized the firm of Albert Waycott & Co., in 1897, and engaged in the sale of brake beams. In 1903 he organized the Damascus Brake Beam Company in St. Louis, Mo., and was president of this company until 1917, when he became chairman of the board. In 1918 he moved to New York and became an inactive member of the board, remaining so until the sale of the Damascus Brake Beam Company to the American Steel Foundries Company, which occurred in 1924.

The Youngstown Steel Door Company has been incorporated in Chicago to engage in the manufacture and sale of steel doors for railway freight cars and has acquired all of the assets and patent rights of the Steel Door, Inc., and the American Steel Door Company. James A. Campbell, president of the Youngstown Sheet & Tube Co., is president of the new company. Charles B. Moore, vice-president of the Oxweld Railroad Service Company, Chicago, is vice-president. John P. McWilliams, general manager of the Oxweld Railroad Service Company, with headquarters at Chicago, has been appointed vice-president and general manager, with headquarters in Cleveland, Ohio. Directors of the new company are J. A. Campbell, Youngstown, Ohio, H. S. Coulby, Cleveland, H. D. Dalton, Cleveland, J. T. McWilliams, Cleveland, C. B. Moore, Chicago, F. F. Prentiss, Cleveland, and J. L. Severance, Cleveland. John P. McWilliams was born on January 8, 1891, in Chillicothe, Ohio, and graduated as a civil engineer from Princeton University in 1913. He entered railway service in 1913 as a timekeeper on the Grand Trunk Pacific, which position he held until October, 1914, when he entered the employ of the Oxweld Acetylene Company. He was promoted to sales manager in 1916. In 1917 he entered the employ of the Oxweld Railroad Service Company as assistant to the vice-president. He was commissioned a captain in the Motor Transport Corps of the United States Army in 1918 and later served as an executive officer of the Welding School at Camp Holabird, Md. He re-entered the employ of the Oxweld Railroad Service Company in 1919 as assistant to the president, with headquarters at New York, which position he held until 1921, when he was promoted to general manager, with headquarters at Chicago. He held the latter position until December 31, 1924, when he resigned to become vice-president and general manager of the Youngstown Steel Door Company.

J. P. McWilliams

David B. Rushmore, one of the consulting engineers of the General Electric Company, Schenectady, N. Y., has resigned and is now located in New York City, with headquarters at the University Club. He graduated from Swarthmore College in 1894 with the degree of bachelor of science and engineering and from Cornell University the following year in the electrical engineering course. In 1897 he received the degree of civil enginer from Swarthmore College and in 1923 the honorary degree of doctor of science from the same college. Mr. Rushmore was with the Westinghouse Electric & Manufacturing Company, and later with the Royal Electric Company of Montreal previous to his service of 25 years with the General Electric Company and the Stanley Electric Company, Pittsfield, which was absorbed by the General Electric Company. In 1905 he went to Schenectady, and for 17 years was engineer of the power and mining department.

The firm of Cook & Riley has been incorporated in Chicago to deal in railway and industrial supplies. It will represent the J. Milton Hagy Waste Works, the E. Arnstein Paint Company, and the Universal Coupling Company. The organizers are T. R. Riley, vice-president, and H. G. Cook, secretary and treasurer of Warren Corning & Co., Chicago.

Laughlin & Cheney, Inc., has been organized, with headquarters at 310 South Michigan avenue, Chicago, by P. L. Laughlin, district sales manager of the Verona Tool Works, with headquarters at Chicago, and B. M. Cheney, general inspector of permanent way and structures, Chicago, Burlington & Quincy, with headquarters at Chicago. The new firm will deal in railway supplies, specializing in the products of the Verona Tool Works.

Le Roy Kramer, vice-president in charge of western sales of the Symington Company, with headquarters at Chicago, has been appointed vice-president in charge of manufacturing and sales of the General American Tank Car Corporation, with headquarters in Chicago. He spent several years in the operating department of the St. Louis-San Francisco and the Chicago, Rock Island & Pacific and from 1912 to 1918 was vice-president of the Pullman Company in charge of the manufacturing and repair shops. During 1918 and 1919 he was federal manager of the St. Louis-San Francisco and the Missouri-Kansas-Texas. In 1919 he was appointed vice-president of the Willys-Overland Company and in 1921 he was appointed vice-president in charge of western sales of the Symington Company, with headquarters at Chicago.

Le Roy Kramer

American Car & Foundry Company

At a special meeting of the board of directors of the American Car & Foundry Company, New York, on February 15, Herbert W. Wolff, vice-president of the company and G. R. Scanland were elected directors. Mr. Scanland, who has for years been auditor of the company, was elected also vice-president in charge of finances and accounts; S. A. Mallette, assistant treasurer, was elected treasurer to succeed S. S. DeLano, deceased; E. S. Block, assistant auditor was made auditor and Miss Alma E. Jackson was appointed assistant treasurer. Mr. Wolff will retain his office in Chicago and continue in charge of sales in that territory. The other officers will be located in New York. G. R. Scanland, the new vice-president and director, was born at Pittsfield, Ill., on May 8, 1877. He entered the employ of the American Car & Foundry Company as a clerk in the auditing department in 1899 and five years later was appointed local auditor of the Memphis district. In 1905 he was appointed traveling auditor and in December of the following year was elected assistant auditor. In November, 1917, Mr. Scanland was elected auditor and now becomes vice-president in charge of finances and accounts and a director. S. A. Mallette, the new treasurer, was born at Union City, Conn., in 1870. He served in the automatic block signal field after leaving school and joined the American Car & Foundry Company when it was organized in 1899. In 1905 he was elected assistant treasurer. E. S. Block, who has been appointed auditor, was born at St. Louis, Mo., on Aug. 31, 1879. He began work as a clerk in the general auditing department of the American Car & Foundry Company in 1900 and was appointed general bookkeeper in 1906. He was appointed traveling auditor in 1911 and in November, 1917, was elected assistant auditor. Miss Alma E. Jackson, who has been appointed assistant treasurer, was born in Callaway county, Mo., and was educated in the public schools, graduating from the St. Louis high school in 1899. She began work with the American Car & Foundry Company in 1900 as a stenographer and now becomes assistant treasurer.

Trade Publications

RIVETERS.—Bulletin R-201, illustrating and describing Hanna pinch bug riveters, has just been issued by the Hanna Engineering Works, Chicago, Ill.

CRANES.—A new general catalogue and a new locomotive crane catalogue have been prepared by the American Hoist & Derrick Company, St. Paul, Minn.

CENTRIFUGAL PUMPS.—"Worthington Centrifugal Pumps Serving Every Industry," is the title of Bulletin No. W-607 which has recently been issued by the Worthington Pump & Machinery Corporation, New York.

ELECTRIC TRAMRAIL.—An eight-page circular illustrating a few of the various plants served by Cleveland hand or electric tramrails, has been issued by the Cleveland Crane & Engineering Company, Wickliffe, Ohio.

CO_2 EQUIPMENT.—Bulletins No. 118 and 118A descriptive of the Apex CO_2 recorder and the principle of operation of the Apex pneumatic CO_2 meter and indicator, have been issued by the Uehling Instrument Company, Paterson, N. J.

LOCOMOTIVE HOISTS.—A circular briefly outlining the savings which may be effected through the use of a locomotive hoist and showing various applications of the Whiting hoist, has been issued by the Whiting Corporation, Harvey, Ill.

COMBINATION GRINDING AND BUFFING MACHINES.—Bulletin No. 1582, descriptive of four new types of motor driven combination grinding and buffing machines, built in ½ and 1 hp. sizes with open and encased spindle extensions, has been issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio.

OIL-ELECTRIC LOCOMOTIVE.—Bulletin No. 44103.1, descriptive of the 60-ton oil-electric locomotive developed by the General Electric, the American Locomotive and the Ingersoll-Rand Companies, is being issued by the General Electric Company, Schenectady, N. Y. Photographs of the locomotive in service, views of the interior, and tables of operating data and specifications, as well as a general description, are included in the booklet.

BORING TOOLS AND REAMERS.—Railroad catalogue No. 25, giving a complete description of Davis expansion boring tools as standard equipment for railroad shops, has been issued by the Davis Boring Tool Company, St. Louis, Mo. The catalogue contains a complete treatise on Davis expansion car wheel boring tools for the car department, and a completely new line of boring tools and reamers recently developed for the locomotive departments of the railroads.

STOKERS.—A bulletin descriptive of the self-contained traveling grate stoker, which has been installed throughout the British Isles and Continental Europe, has been issued by the Combustion Engineering Corporation, New York. The stoker is adaptable to a wide range of fuels, including non-coking bituminous coals, anthracite coals, coke breeze and lignites, and may be applied to boilers of all sizes and types, it being particularly suited to boilers ranging up to 600 hp.

BALANCING GRINDING WHEELS.—The Norton Company, Worcester, Mass., has issued a 24-page brochure entitled, "The balancing of grinding wheels," in which the advantages and economy of balancing the grinding wheel are briefly outlined. Balancing for precision grinding and the balancing of flanges for off-hand grinding are then discussed and directions for balancing off-hand wheels given. The principle of adjusting the balancing weights to obtain a range from the maximum to the minimum counter-balance is also shown.

CAR SILL SECTIONS.—Sectional drawings of center sill section B 112 and side sill channel C 211 are shown in an eight-page brochure issued by the Carnegie Steel Company, Pittsburgh, Pa. The center sill section is the A. R. A. design incorporated in 1923 in the proposed designs for four standard box cars, a relatively large number of which have since been built. The side sill channel, while not an A. R. A. design, has been accepted for use on cars already built, considerable lateral stiffness being afforded by the wide flanges with which it is rolled and to which side framing and floor system can be readily attached.

Personal Mention

General

T. M. Kirkby, mechanical assistant to the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has been promoted to special representative, with the same headquarters.

J. S. Netherwood, whose promotion to assistant superintendent of motive power and equipment of the Southern Pacific, Louisiana lines, with headquarters at Algiers, La., was reported in the January issue of the *Railway Mechanical Engineer,* was born on November 18, 1889, at Lohn, Tex. He graduated from the Agricultural and Mechanical College of Texas in June, 1911, and entered railway service immediately thereafter as a draftsman in the office of the mechanical engineer of the Southern Pacific at Houston, Tex. He was promoted to chief draftsman in February, 1913, and held that position until September, 1918, when he was promoted to mechanical engineer of the Texas lines, with headquarters at Houston, Tex. Mr. Netherwood remained in that position until his recent promotion to assistant superintendent of motive power and equipment.

P. W. Kiefer, whose promotion to engineer of rolling stock of the New York Central, with headquarters at New York, was announced in the February issue of the *Railway Mechanical Engineer,* entered railway service as an apprentice in the mechanical department of the Lake Shore & Michigan Southern (now a part of the New York Central) and in 1916 he entered the equipment engineering department. He later served as locomotive designer, leading draftsman and on dynamometer car tests and in July, 1920, he was promoted from the position of chief draftsman in the locomotive department of the equipment engineering department to the position of assistant engineer in the office of the engineer of rolling stock. In March, 1923, Mr. Kiefer was promoted to assistant engineer of rolling stock and in May, 1924, he was promoted to engineer of motive power of the Lines East and West of Buffalo, N. Y.

H. W. Williams, special representative to the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has been promoted to superintendent of motive power of the Western Lines, with headquarters at Tacoma, Wash., succeeding Frank Rusch, deceased. Mr. Williams graduated from Purdue University in June, 1910, and after one year as an instrument man on the Chicago Junction, entered the service of the Chicago, Milwaukee & St. Paul as a draftsman in the office of the engineer of design. He was transferred to the construction forces at Lewistown, Mont., in December, 1913, and in March, 1914, was promoted to structural draftsman in the electrification department. Mr. Williams was promoted to chief draftsman in January, 1915, and to assistant engineer in 1917. He was appointed special representative to the general superintendent of motive power in November, 1920.

Master Mechanics and Road Foremen

George Higgs has been appointed road foreman of engines of the Central of New Jersey, succeeding A. Kirkendall, deceased.

F. T. McClure has been appointed road foreman of engines of the Eastern division of the Atchison, Topeka & Santa Fe, with headquarters at Ottawa, Kan.

E. C. Carey has been appointed assistant road foreman of engines of the Norfolk & Western, with headquarters at Bluefield, W. Va., succeeding W. F. Perkins, promoted.

G. F. Burke, general foreman of the Southern Pacific, with headquarters at Roseville, Cal., has been promoted to master mechanic, with headquarters at Tucson, succeeding O. B. Schoenky.

O. B. Schoenky, master mechanic of the Southern Pacific, with headquarters at Tucson, Ariz., has been promoted to superintendent of motive power, with headquarters at Los Angeles, Cal., succeeding Patrick Sheedy, who has retired.

John P. Morris, whose appointment as master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, was announced in the January issue of the *Railway Mechanical Engineer,* was born in 1889 at Fort Madison, Iowa. He attended the Fort Madison public schools, entering the employ of the A. T. & S. F. as a machinist helper on September 27, 1904. He became a machinist apprentice in June, 1906, and from February, 1911, to January, 1916, he was a machinist on the Missouri division. In January, 1916, he was promoted to assistant roundhouse foreman, with headquarters at Shopton, Iowa; in July, 1917, promoted to roundhouse foreman at Fort Madison; and in April, 1923, to general shop foreman, locomotive department, in which capacity he remained until his appointment as master mechanic at Chicago.

J. E. Stone, whose appointment as master mechanic of the Salt Lake division of the Southern Pacific was announced in the February issue of the *Railway Mechanical Engineer,* was born on July 19, 1885, at Shoshone, Idaho. He entered railroad service in 1902 as a machinist apprentice on the Oregon Short Line. From August, 1906, until December, 1908, he was machinist and shop draftsman at Pocatello, Idaho; from January, 1909, until May, 1911, draftsman in the office of the superintendent of motive power at Salt Lake City, Utah; from May, 1911, until April, 1912, draftsman of the Ray Consolidated Copper Company, Ray, Ariz., and from April, 1912, until March, 1913, assistant machine shop foreman of the Oregon Short Line at Ogden, Utah. He was then appointed general foreman. On July 1, 1914, the Southern Pacific took charge of the Ogden shops and Mr. Stone was retained as general foreman until August, 1920, when he was transferred to Sparks, Nev., as assistant master mechanic of the Salt Lake division.

Car Department

W. G. Brown has been appointed division car foreman of the W. N. & P. division of the Boston & Maine, with headquarters at Worcester, Mass.

Andrew Craig has been appointed division car foreman of the Terminal division-freight, of the Boston & Maine, with headquarters at Charlestown, Mass.

Shop and Enginehouse

Frank Fouse has been appointed shop superintendent of the Lehigh Valley, with headquarters at Packerton, Pa.

A. J. Dietrich, roundhouse foreman of the Atchison, Topeka & Santa Fe at Barstow, Cal., has been transferred to Bakersfield, Cal., succeeding R. T. Gorman.

C. H. Wall, division foreman of the Atchison, Topeka & Santa Fe at Barstow, Cal., has been appointed roundhouse foreman, with headquarters at Richmond, Cal.

R. T. Gorman, roundhouse foreman of the Atchison, Topeka & Santa Fe at Bakersfield, Cal., has been appointed division foreman, with headquarters at Barstow, Cal.

Purchasing and Stores

D. W. Corcoran, traveling storekeeper of the Chicago & North Western at Chicago, has been promoted to assistant general storekeeper, with the same headquarters.

F. B. Taylor has been appointed division storekeeper of the Iowa division of the Chicago & North Western, with headquarters at Clinton, Iowa, succeeding E. J. Leonard.

W. H. Fitzpatrick, traveling storekeeper of the Chicago & North Western, at Chicago, has been promoted general storekeeper, with the same headquarters, succeeding A. L. Tucker, who has retired.

Obituary

C. F. Lape, for nine years master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at San Bernardino, Cal., died on January 6, at the age of 81.

Arthur Kirkendall, road foreman of engines of the Central of New Jersey, with headquarters at Jersey City, N. J., died at his home in Westfield, N. J., on February 4, at the age of 63. He had been in the service of the Central of New Jersey for 42 years.